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In this issue

Driving the Elton Tunnel • Flotation Shorthand

How the Geological Surv... Serves Alaska

Recovery of Lode Gold ...

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31.

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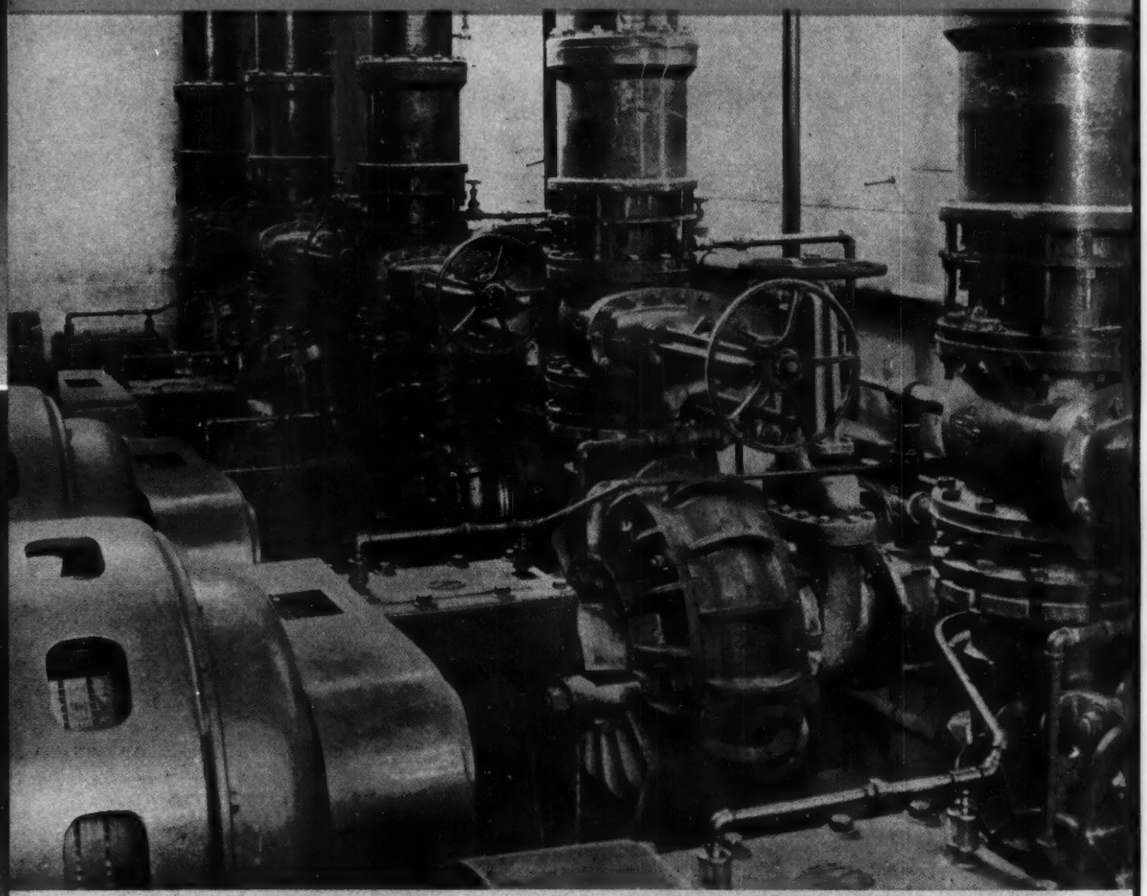
What 5 Hydroseal Pumps did in their 4th Year of Service

at a Large Copper Mill in the Inter-Mountain District of U. S.



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Strategic Mineral investigations of the U. S. Bureau of Mines involve considerable sampling. In the third quarter of 1939, 4,580 analyses and tests were made on samples received. How this volume of work is handled efficiently will be told next month by Edmund S. Leaver, supervising engineer of the Precious Metals Section, who will also describe the analytical methods employed.

▼

Alaska has been well served by the U. S. Geological Survey, as is shown by Philip S. Smith, Chief Alaskan Geologist, on pages 54 to 56 of this issue. The Territory is larger than most people think. The atlas puts its area at 586,400 sq. mi. —more than twice as big as the State of Texas.

▼

Subscribers abroad probably experience considerable delay in receiving their copies, thanks to interference with mails in the "war zone." From Berlin comes a letter, dated March 12 and received April 2, acknowledging receipt of our letter of Nov. 24, 1939, as having "just arrived."

▼

"Ca-canny strikes which slowed down development, mining, and other work with deplorable effect," says a recent report of San Francisco Mines of Mexico to its shareholders, occurred frequently during the eight months in which its new collective labor contract was being negotiated.

▼

President Cardenas has discovered that Mexico's national oil industry is not going well, states Banco Nacional de Mexico in its latest monthly summary, and has declared that the workmen, instead of giving their constant cooperation, maintain an unbecoming attitude, and deal with the Oil Administration as if it were a private enterprise, continually opposing it and resolutely demanding special privileges which would be harmful to it.

H. C. PARMELEE
Editorial Director

ENGINEERING AND MINING JOURNAL

H. W. CLARKE
Vice-President

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COVER ILLUSTRATION: The geophysical survey at Steep Rock Lake entails some heavy work. The torsion-balance insulator hut is being moved to a new location. See pages 46 and 47. Photo by Associated Screen News, Ltd., Montreal. (Cover space released for editorial use by A. R. Wilfley & Sons, Inc.)

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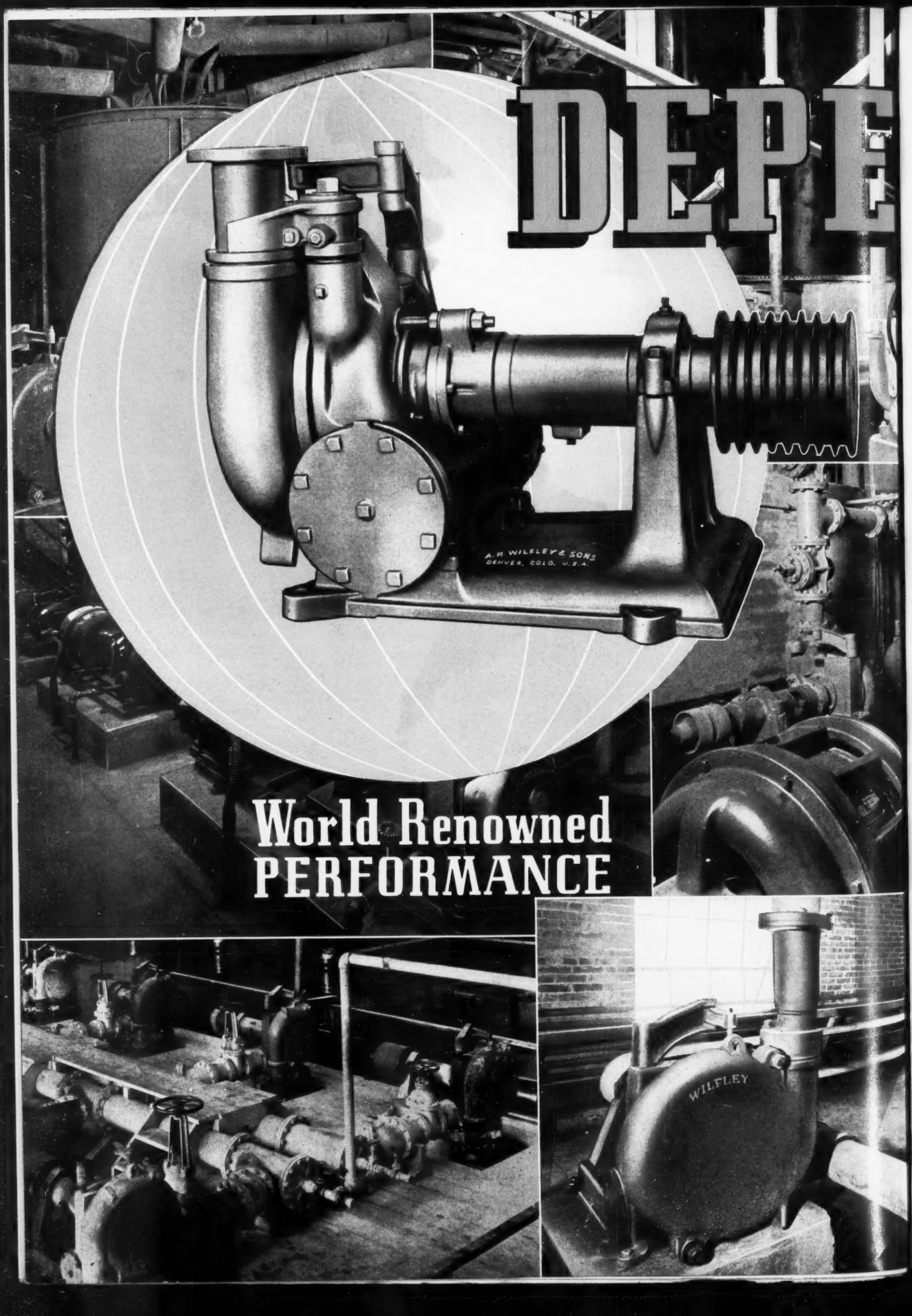
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Volume 141 APRIL 1940 Number 4

Back to Pick, Shovel, and Wheelbarrow

APPARENTLY it is necessary once in a while to reargue the case for the machine in relation to employment; to reiterate the fact that machinery is not antisocial; to defend science, engineering, invention, and technologic progress against the fallacy that they are responsible for our economic ills. Unfortunately, such notions prevail in high places in the Government, from the President down, if one is to take official utterance at face value. The latest evidence is embalmed, we hope, in S.3560, a bill to reduce unemployment, introduced in the Senate last month by Senator Joseph C. O'Mahoney, of Wyoming.

Stripped of its involved verbiage, the bill proposes to use the taxing power of the Government to reward producers that employ many men and few machines, and to penalize those that use many machines and few men. Senator O'Mahoney would levy a new tax on producers—a "labor-differential tax" on "labor-differential income." The latter would be determined by deducting from gross income the cost of materials and supplies, plus salaries and wages up to $3,000 per annum per person. But, a "labor-differential credit" is to be allowed against the "labor-differential tax," consisting of a percentage of the salaries and wages deducted from gross income.

It's all very confusing, but try to follow it closely. The best is yet to come. You may not have to pay any tax. If you employ enough men, so that your "labor-differential credit" exceeds the imposed tax, the Secretary of the Treasury will pay you the difference. And if business is so bad that you have no taxable income, the benevolent Treasury will reward you with a percentage of the amount you have paid for salaries and wages.

Here is an unprecedented opportunity to turn back the clock of progress to the horse-and-buggy days lamented by the President when the Supreme Court invalidated the N.R.A. as a pattern for American life. Any producer whose record shows increasing output per man through the use of machines can now get credit for retiring machines and employing more men. True, production will fall off, prices will rise, and distribution will be diminished. But by some hocus-pocus unemployment will be reduced. Imagine the porphyry coppers without steam shovels, but with thousands of men working by hand. Or the coal mines in the Senator's own State of Wyoming without cutting machines and mechanical loaders, but plenty of picks, shovels, and wheelbarrows.

Did the Senator personally conceive this brilliant bit of economics? We doubt it. It sounds more like some of the bright Administration boys with whom he has to contend on the Temporary National Economic Committee. Nevertheless, it is disturbing because he is chairman of T.N.E.C., which has been studying the American economy for nearly two years, and expects soon to hear witnesses on technology and employment. The Senator's bill prejudges the case for technologic progress, and discourages hope for constructive suggestions from his committee. Machinery poses a problem in American economy, but the solution is not to be found in eliminating it.

Zinc Producers Seek Relief

ZINC PRODUCERS continued last month their vigorous, but thus far futile, protests against the tariff reduction on zinc and cadmium effected in the trade treaty with Canada. This time they appeared before the Senate Committee on Finance, which held hearings on the extension of the reciprocal trade agreements act that expires this year. The case for restoration of the tariff was made by representatives of the American Mining Congress, American Zinc Institute, Tri-State Zinc and Lead Ore Producers Association, and by Edward H. Snyder, general manager, Combined Metals Reduction Company, Utah. A technical defense of the State Department's action in reducing the tariff was introduced into the record.

Representatives of the industry are to be commended for the restraint with which they presented their case. Without forensic eloquence, but with an abundance of logic and hard facts, they established several incontrovertible points: The State Department blundered origi-

nally in including zinc and cadmium in the Canadian treaty; it failed to consult the Bureau of Mines about the zinc industry, but relied on its own inexpert judgment; it failed to adhere to its expressed policy on trade bargaining, which was to modify tariff rates only on those commodities of which the country in question was the chief exporter to the United States; and finally, although the Department repeatedly sought to quiet the industry's fears by referring to the "escape clause," it has consistently refused to invoke that provision in the treaty, which would be justified by the fact that a third country—Mexico—is the principal beneficiary of the Canadian agreement.

So the zinc producers, having received courteous treatment, but no action, at the hands of the State Department, laid their case before the Senate Finance Committee. Chairman Pat Harrison was glad to learn that the State Department had at least been courteous in the matter, and then added: "To my mind, just from your testimony and what I know about this situation, I think you have something to be aggrieved about."

The whole matter simmers down to this: The State Department made a mistake in the first instance and, humanly enough, dislikes to acknowledge it. But if it wants the country to have confidence in its trade program it must be fair and honest in its dealings with American industry. Otherwise the Congress must—and probably should in any event—limit the Department's freedom of negotiation.

Strategics and Politics

CONSIDERING the current popularity of scuttling your own ship, it is not surprising that political assault from some quarters should be made on the national defense aspect of the Government's strategic minerals program. The Thomas bill was enacted in 1939 "to provide for the common defense by acquiring stocks of strategic and critical materials essential to the needs of industry for the manufacture of supplies for the armed forces and the civilian population in time of national emergency." A supplementary objective was "to encourage, as far as possible, the further development of strategic and critical minerals within the United States." A "buy-American" clause was inserted, making mandatory the purchase of American materials *if* they are available in sufficient quantity and satisfactory quality.

The language and intent of the Thomas bill were clear and unequivocable. It was a national defense measure and not a device to subsidize domestic production of low-grade strategic minerals, nor to increase employment in the domestic mining industry. Nevertheless, during hearings on the bill, Andrew J. May, chairman of the House Committee on Military Affairs, and James G. Scrugham, Representative from Nevada, seemed to display a deeper interest in subsidy and employment than in requirements for national defense as conceived by representatives of the Army and Navy Departments. Why?

Well, Mr. Scrugham has long been an advocate of creating a reserve supply of domestically produced and processed strategic materials. He has political power in the House as a member of the subcommittee on Naval Appropriations. In 1936 and 1937 he tried, unsuccessfully, to launch the Navy on a program of purchasing strategic minerals. In 1938 he was successful, though the Senate refused to accept the "exclusively domestic" clause. Nevertheless, the Navy actually called for bids on 40 per cent manganese ore, which occurs in Mr. Scrugham's State, but finally rejected them and bought domestic ferromanganese.

Mr. May's interest is different. After the Thomas bill was enacted, Mr. May was revealed not only as chairman of the House Committee on Military Affairs, but also as president and one of the incorporators (Dec. 1, 1937) of the Greenbrier Mining Company, Virginia, which bid unsuccessfully for Government contracts for manganese ore, and sought favors of delay in delivery and exemption from filing the customary bond.

Other attempts have been made to obtain consideration for domestic ores that do not meet the strict specifications of the Army and Navy Munitions Board, but thus far all have failed. Appeals to relax the specifications have reached the Secretary of War and the President, but both have defended the intent of the Thomas bill as a measure for national defense. Without prejudice to domestic producers, who are to be favored if they can meet the requirements, these officials have refused to use the act for relief of unemployment.

Both of the provisions of the Thomas bill are being carried out. Reserve supplies of high-grade strategic and deficient minerals and metals are being acquired up to the limit of appropriations. The Bureau of Mines and the Geological Survey have done creditable field work investigating domestic mineral deposits so that the Government may have an inventory of national resources. The two activities are complementary, as they were designed to be: one to meet an immediate emergency, and the other to provide future insurance. Any attempt to divert the original aim of the act should be resisted. If Messrs. May and Scrugham, or others, want to provide subsidy for sub-standard strategic minerals, and relieve unemployment in the mining industry, let them do it directly and not by trying to scuttle a measure for national defense.

Driving the Elton Tunnel

John B. Huttl
Assistant Editor

Portal of the Elton tunnel, about one mile northwest of the Tooele smelter

Despite difficulties due to ground and water the heading, started in 1937, had reached the half way mark at 12,600 ft. by mid-March of the present year

CAREFUL SELECTION of appropriate equipment, good organization, experienced direction, and coordination of different underground and surface working phases are prerequisites to attainment of speed and low costs in driving tunnels. Though fast work in such undertakings usually is associated with expert contractors, who work either with a seasoned crew or draft the best men available, in conjunction with special equipment, application of the principle mentioned and mechanization of underground work at the Elton tunnel project, in Tooele County, Utah, have proved that a tunnel may be driven at a good speed in difficult ground without the necessity of contracting the work. The tunnel, named after J. O. Elton, manager of the International Smelting & Refining Company, whose vision and efforts brought the undertaking to realization, is being driven by the National Tunnel & Mines Company, a subsidiary of International Smelting, and when completed will have a total length of nearly 24,000 ft. It is carried at a grade of 0.35 per cent with a concrete-lined drain ditch, measures about 11x10 ft. in cross-section, and its object is to provide facilities for drainage of the deep mines and rapid ore haulage between the company's mining properties in the Bingham area and the Tooele smelter, to decrease the time required to get underground men to their working places, and to investigate the previously unexplored territory cut.

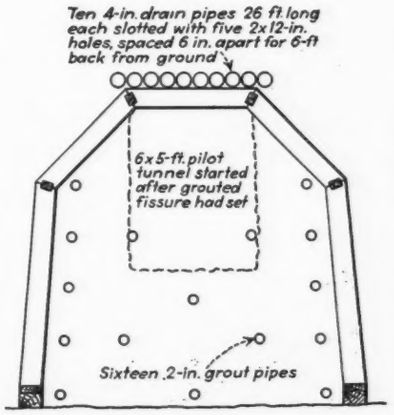

Ten 4-in. drain pipes 26 ft long each slotted with five 2x12-in. holes, spaced 6 in. apart for 6-ft back from ground
6x5-ft. pilot tunnel started after grouted fissure had set
Sixteen 2-in. grout pipes

Fig. 1. . . . When a wide fissure was encountered at 8,847 ft., admitting water, quicksand, and pebbles, it was grouted through 16 2-in. pipes driven into the face at points shown, after driving the 10 4-in. slotted drain pipes, 26 ft. long, ahead to trap the water

The portal is about a mile northwest of the smelter and the tunnel passes 450 ft. beneath the site. The ultimate outlet will be on the 2,500-ft. level of the Utah Apex mine.

Actual work on the tunnel was started in June, 1937, but operations were suspended on two occasions because of adverse economic conditions. The project was reopened in December, 1938, and work has continued since. Until solid rock was struck at 8,472 ft., all work was done in alluvial material, mostly loose gravel, requiring heavy timbering, and in order to overcome difficulties such as flows of water and mixtures of quicksand and pebbles, encountered at times, called for development of special measures on the part of the management and staff. At a point some 6,000 ft. from the portal, water flow and pressure reached such a degree as to make imperative a realignment of the tunnel. As a consequence, and after preliminary testing of the ground by churn-drill holes, the line of the bore was turned 42 deg. to the right at 5,604 ft., or 500 ft. back from the original breast, where water was cut before driving again parallel to the original alignment, which was done at 9,000 ft. from the portal.

No particular difficulties were encountered in solid ground until the 8,847-ft. point was reached, where a fissure 8 to 10 ft. wide, with a back of 1,000 ft., and containing water, quicksand, and pebbles, temporarily halted the advance. The pressure was such that the tunnel was filled solid almost instantly for a distance of 80 ft. from the face, with the overflow extending another 100 ft. This obstacle was overcome in an ingenious manner. With a water flow of some 300 g.p.m. at a pressure of 300 lb. per square inch, it was decided first to trap the water and then grout the fissure. This was accomplished by driving above the arch of the timbers ten 4-in. pipes, each 26 ft. long and provided with 2x12-in. slots on the back, a distance of 20 ft. through the fissure after the caved ma-

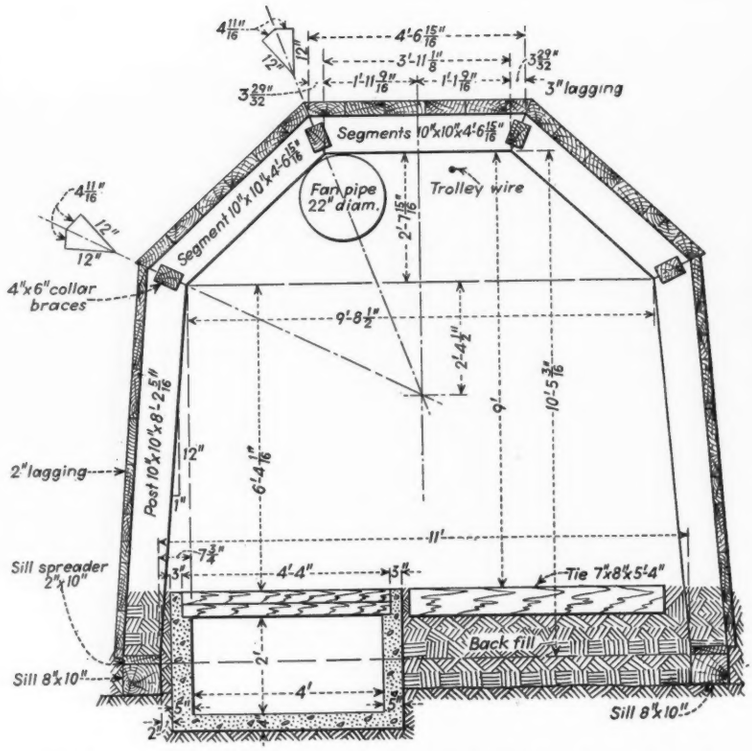


Fig. 2. . . . Typical cross-section of Elton tunnel, showing the method of timbering and the concrete drain ditch

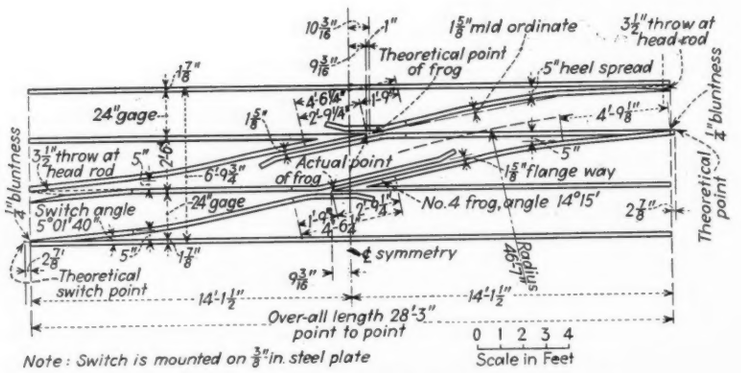


Fig. 3. . . . The movable back switch used in the track layout. An average distance of 300 ft. is kept between it and the front switch

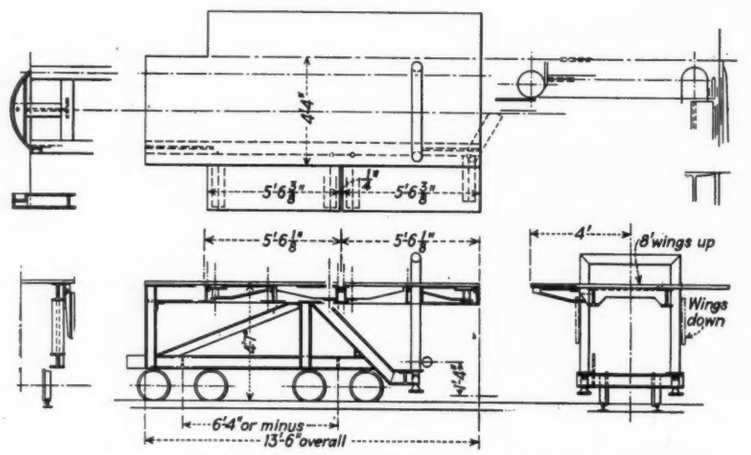


Fig. 4. . . . A special design of jumbo, shown here, was developed by the company for drilling

A finished section of the tunnel. Dimensions of the timber sets are shown in Fig. 2

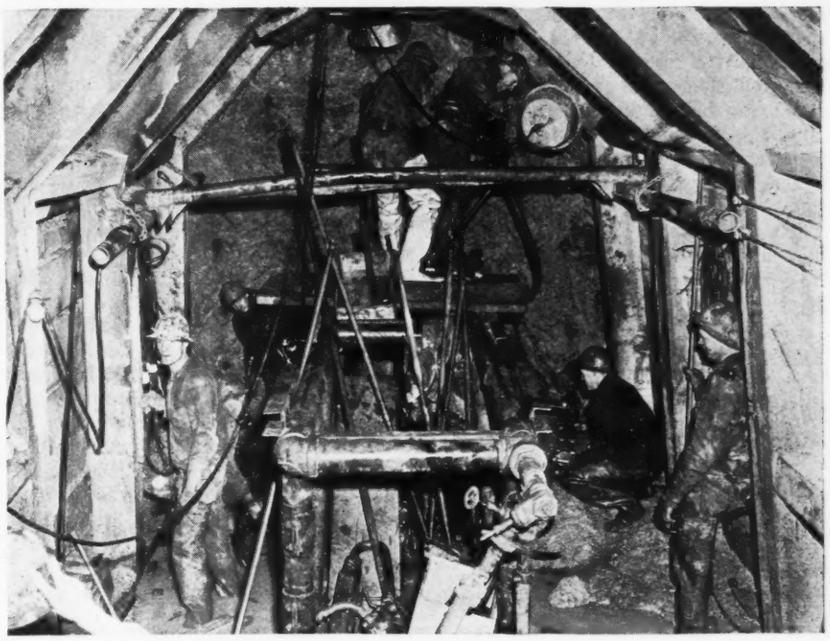
terial had been removed to within two sets of the fissure and 6x8-in. breast boards set up close to the arch of the tunnel timbers.

Grouting operations were conducted through sixteen 2-in. pipes driven into the fissure at points indicated in Fig. 1. These were 26 ft. long and contained two ½x2-in. holes about 12 in. from the pointed end for grout outlets. Driving of the pipes was done with a 30-ft. ram made from 65-lb. rail. The grout mixture (one sack of cement to 45 gal. of water) was pumped slowly and under pressures varying from 100 to 900 lb. per square inch until it seeped from the 4-in. pipes above the timbering and other points at the fissure face, there being used in this work a total of 153 sacks of cement, each holding 100 lb. Another 96 sacks of cement were used in grouting the bottom and periphery of the section to be bored. The grouted section was then allowed to set, after which a pilot tunnel, 6x5 ft. in cross-section, was started close to the top of the tunnel and driven through the fissure into solid rock. It was subsequently enlarged to 11x10 ft. Since then several open fissures, varying in width from 3 to 4 ft. and filled with gouge and crushed quartzite, have impeded the advance. On Feb. 16 the heading had reached the halfway mark at 12,000 ft. from the portal, with the water flow measuring 5,000 g.p.m. The high point in the flow in December, 1939, was 5,514 g.p.m. Distance driven during 1939 was 5,354 ft.

Fig. 2 shows a typical cross-section of the tunnel, method of timbering, and the layout of the concrete drain ditch. Timbering consists of 4-ft. 6 13/16-in. segment sets spaced on 5-ft. 4-in. centers (6-ft. centers are now used), the individual posts and segments being made from 10x10-in. timber. The sill, sill spreaders, and collar braces are cut from 8x10-in., 2x10-in., and

4x6-in. materials respectively. The sides of the 2x4-ft. drain ditch consist of concrete slab 5 in. thick; the poured bottom is kept at a thickness of 4 in. Excavation of the preliminary channel is done with a special scraper actuated by a Sullivan tugger hoist. Sections of 6-in. timber cover the top of the completed ditch. The wooden sleepers supporting the 24-in. gage track made from 45-lb. rails rest on tamped backfill. A short distance to the right and left of the center line are carried the trolley wire and a 22-in. fan pipe. Two-inch and 3-in. lagging are used.

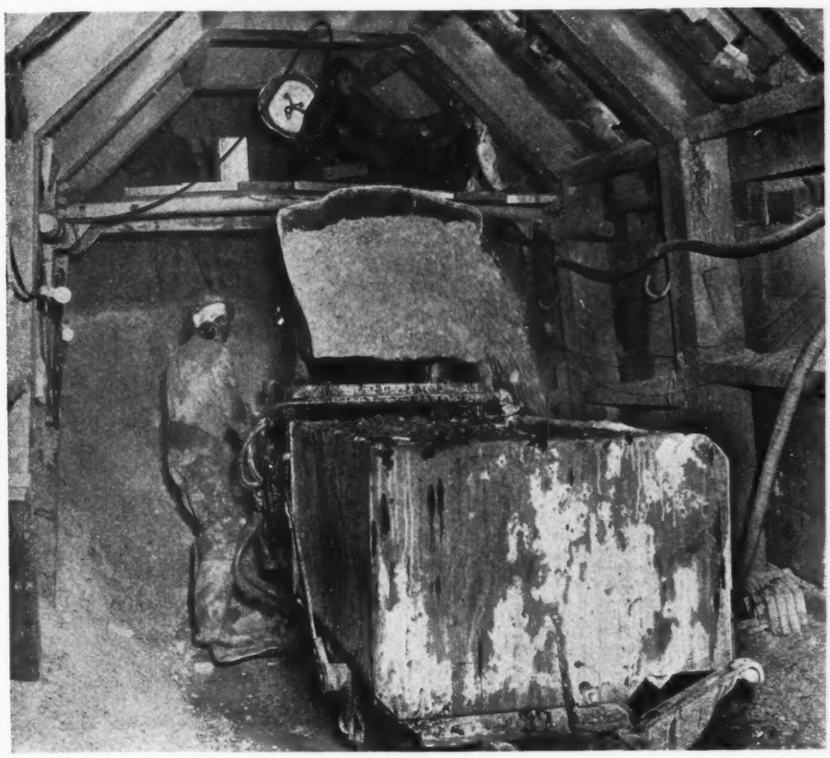
Of particular interest to the visitor is the practical track layout behind the tunnel face. Use is made of a movable back switch as in Fig. 3, closely resembling what is known as a California switch, and a front switch somewhat similar in design except that it has one front single center track to serve the breast of the tunnel. An average distance of 300 ft. is kept between the front switch and the back switch so as to provide ample room for empty cars. Behind the back switch another 60 to 90 ft. of track is carried to store the extra No. 20 Eimco loader, timber trucks, drilling jumbo, and other equipment. The back switch rests on top of the rails, but the front switch is set down flush with the rails on top of the sleepers. The latter unit is moved ahead by means of a special sled arrangement with upturned ends first placed under the front end of the switch to obviate any digging into the sleepers. Moving of the switches is done by electric locomotives. The single track ahead of the front switch is laid in 6-ft. rail sections, and standard 30-ft. rail lengths are used between the front switch and the back switch. Being welded to ½x4-in. steel plates serving as sleepers, the 6-ft. rail sections are extra rigid and can stand considerable abuse.



Drilling in the heading with the jumbo. A round consists of 34 9-ft. holes

The daily moving of switches and subsequent rearrangement of rails is accomplished in the following manner: After the sled arrangement mentioned previously has been placed under the front end of the switch, the electric locomotive is attached and the front switch pulled ahead from 30 to 60 ft., depending on the distance it is back of the face. This is followed by pulling up the 6-ft. sections of the center lead track, and laying the double tracks made up of 30-ft. lengths. In the face area no slide rails are used to advance the mechanical shovel. Instead, a 3-ft. rail section is placed just ahead of the shovel, which is replaced with a 6-ft. section as soon as the round has been cleaned up 3 ft. in advance of the short rail section.

Mucking out the heading with a No. 20 Eimco loader



Drilling operations are carried on from the special jumbo developed by the company and explained in detail in Fig. 4. It is equipped with universal couplings and slip arms for the five drilling machines employed, air and water pipes, with one connection on each line at the rear for the short air and water hoses leading to the drills, appropriate airline oilers, and wiring for the mounted floodlights. The 34-hole round is drilled 9 ft. deep (currently in quartzite) with I-R DA 35 and Worthington H 80 drifters, all fitted with automatic feeds. Four sizes of Timken detachable bits (⅛ in. change) are used, with the starter bits 2¼ in. and the finishers 1⅞ in. Blasting is done with both 1¼x8-in. Atlas and Columbia 40 per cent gelatin dynamite, and Atlas blasting caps. Electric firing is practiced exclusively, the wiring and switch arrangements following conventional design. Before firing the round, the jumbo is pulled back from the face, and light for loading the holes and subsequent removal of broken material is furnished by two homemade floodlights, each using a 500-watt lamp, mounted on the sides of the tunnel.

Mucking operations are completely

mechanized, the work being done by the Eimco No. 20 loaders mentioned previously. These load into 50-cu.ft. Coeur d'Alene side-dump mine cars, which are hauled in 20-car trains by 10-ton Atlas combination battery-trolley locomotives to the portal of the tunnel, where the contents are dumped into gondola cars of the Tooele Valley Railroad to be used for ballast and fill for bridges and other projects. The trolley wire is carried to within 250 ft. of the face.

The heading crew consists of ten men —namely, seven men on drill and mucking work, two motormen, and a shift boss.

Ventilation is provided by a 15-hp. TM-8, 3,600 r.p.m. Coppus blower exhausting about 5,000 cu.ft. per minute under present conditions from the face of the tunnel. This fan is always kept some 40 ft. from the breast. It is mounted on skids and is moved ahead as the tunnel advances. In this position the fan picks up all the fumes and dust from blasting within 5 min. The discharge end is attached to a 22-in. ventilation pipe leading to an I-R 20-hp., 3,600 r.p.m. motor blower about 4,500 ft. distant and 100 ft. beyond a 4x8-ft. timbered ventilation raise. The raise is 6,500 ft. from the portal, and air is discharged to the surface through a 22-in. metal ventilation pipe contained therein. The raise being downcast supplements the fresh air coming in from the portal, and has greatly improved ventilation. Power lines are carried down through an 8-in. churn-drill hole situated about 8,200 ft. from the portal. A motor generator set has been installed at this point.

Water made by the tunnel in the face area is handled by a 1,200 g.p.m. Fairbanks-Morse centrifugal pump mounted on skids, which is usually kept about 50 ft. back of the face. To it are attached some 100 ft. of discharge line emptying into the drain ditch, whence the water flows by gravity to the portal of the tunnel to be used for irrigation purposes. The flow of the water from the tunnel is in excess of 5,000 g.p.m., and is sufficient in quantity to irrigate 1,000 acres of average farm land.

Daily advance of the heading varies according to the nature and condition of the ground. Under favorable conditions a distance as high as 46 ft. has been driven, the average daily advance being around 24 ft. at this time. The best footage per month made so far has been 982 ft. The surface plant at the portal is modern in every way, and the different shops are adequately equipped to handle any repairs on locomotives, cars, loaders, drills, drill bits, and prepare tunnel timbers. Total number of men employed on the project, including the superintendent and his staff, is 62. A. W. Filion, superintendent, is in charge of all operations incident to the work.

Flotation Shorthand

A symbolic representation of flowsheets which saves space and facilitates comparison

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A RECORD of flotation flowsheets in the form in which they are normally presented requires at least as many letter-size sheets as there are items in the record, and comparisons for purposes of generalization impose a tax on the memory that is beyond the capacity of myself at least. The symbolic form described in the following paragraphs both saves space and makes for easy comparison. Flowsheets used for illustration range from the simplest to the most complicated in my file.

The method of constructing a symbolic flowsheet is as follows:

1. Divide the operation into *stages*. A stage is defined as any unit operation to which the pulp or any part thereof is subjected, e.g. grinding, conditioning, desliming, etc., or flotation. A flotation stage is a flotation treatment that produces one combined overflow sidestream (as from the first 30 ft. of a 100-ft. pneumatic cell, or the first 5 cells of a 12-cell sub-aeration machine, or the combined overflow from two scavengers in series, or the like) and an underflow. Reference to Fig. 1, which shows the Miami flowsheet thus subdivided into stages, will make this clear.

Stage 1 comprises the first half of a 100-ft. matless cell and Stage 2 the remainder of the cell.

2. Set down the stages that treat primary pulp successively in a line parallel to the left-hand margin of the diagram and indicate the character of the stages according to the symbols in Table I. Successive flotation stages are indicated by successive integers, starting with one and progressing in order down the parallel rows of stages described in paragraphs 4 and 5 following.

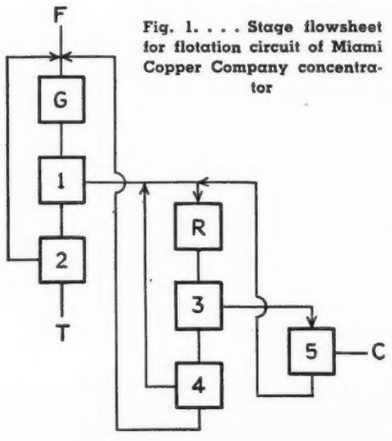


Fig. 1. . . . Stage flowsheet for flotation circuit of Miami Copper Company concentrator

3. Indicate products leaving the various stages by lines according to the convention that underflows run toward the bottom of the diagram and overflows toward the sides. If any product is finished, indicate that fact on the flow line by the corresponding symbol from Table I. Other flow lines should now be extended to their destinations. Thus in Fig. 1 the run on the primary pulp comprises successively grinding and two stages of flotation, the first making a sidestream middling that goes to a regrind stage, the second making finished tailing as underflow and a sidestream that returns to the original grinding stage.

4. Set down the stages that treat primary (once-floated) middling in a line to the right of and paralleling the representation of the run on primary pulp, and draw in the flow lines as directed in (3). See Fig. 1.

5. Similarly set down progressively, in parallel rows to the right, the stages that treat secondary and tertiary middling, etc.

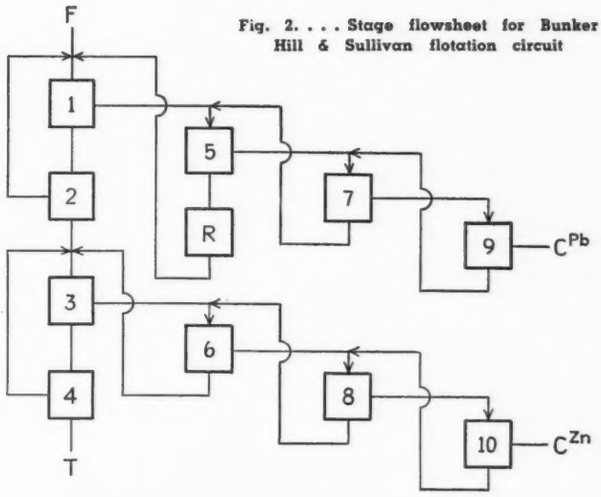


Fig. 2. . . . Stage flowsheet for Bunker Hill & Sullivan flotation circuit

6. With the stage flowsheet thus set up, the symbolic flowsheet is written as follows:

(a) Starting with the first stage of the primary run, write down the symbols for successive stages in order to the end of that run. In writing down flotation stages at this point, however, the number of such stages down to the point that a finished product is taken off or a product is turned back is set down in the symbol, rather than the integral designation of the stage. Thus for the primary run in Fig. 1, set down G·2 to indicate one grinding stage and two successive flotation stages before a finished product is taken or any product is counterflowed. The period mark between the G and the 2 indicates underflow from G to the first of the two flotation stages, and, generally, a string of symbols connected by such period marks designates the string of operations on a particular kind of pulp, e.g. primary, primary middling, etc.

(b) Referring again to Fig. 1, append T to designate finished tailing from the last flotation stage indicated, and the subscript "$_{-G}$", the subscriptual position indicating counterflow or return, the "$_G$" giving destination, the minus sign indicating that the returned material is sidestream. Subscripts always refer to a product of the last of the stages to the symbol of which they are appended. The complete symbolic presentation of the run on primary pulp is now $G{\cdot}2T_{-G}$.

(c) Next write the symbols for the run (or runs) on the primary sidestreams. Sidestream runs are always introduced by minus signs with a superimposed numeral designating the stage from which the sidestream originates. In Fig. 1 the primary sidestream comes from Stage 1, so that the symbol for the run on primary middling starts off $\overset{1}{-}$. The successive stage symbols are R·2. No finished products are made. Underflow of the second flotation stage on this run returns to G, which is indicated by the corresponding destinative subscript *without* a minus sign, while overflow returns to R, indicated by a second subscript *with* a minus sign. The complete symbol, then, for the run on primary middling is $\overset{1}{-}R{\cdot}2_{-R,G}$. If, as at Bunker Hill & Sullivan (see Table II), other sidestreams are taken off the primary pulp, the primary-middling flows thereon are set down in the symbolic flowsheet in order, directly following the symbols for the first sidestream, but inclosed in parentheses. This is explained below in the analysis of the Bunker Hill & Sullivan symbol.

(d) Write the symbols in order for the runs on secondary and tertiary middling, etc., as prescribed in the preceding paragraph.

The Bunker Hill & Sullivan symbol (Table II) is translated into a stage flowsheet in Fig. 2. It will be seen that two separate circuits treat each the primary, secondary, and tertiary middlings. The second of the circuits in each case is indicated in the Bunker Hill & Sullivan symbol by inclosing the symbol therefor in parentheses following, in each case, the symbol for the first of the middling products from the preceding stream.

When, as at Consolidated Mining &

Table I—Symbols Used in Constructing "Shorthand" Flowsheet

Ae aeration
B gravity concentration
C concentrate (exponent indicates character, e.g. C^{Pb} = lead concentrate)
Cg conditioning
Ds desliming
F flotation feed
G grinding preceding first flotation stage
Integers, flotation stages in arithmetic progression from 1, numbering first through the stages on the primary pulp, then all those on once-floated middling, twice-floated middling, etc.
R, R′, R″, etc., successive regrindings of an unfinished product.
T tailing

Table II—Flotation Flowsheets of 16 Well-known Mills, Expressed in "Shorthand"

Ajo	$1T\overset{1}{-}1C{\cdot}R{\cdot}2T_{-3}\overset{3}{-}1C_3$
Aldermac	$2T\overset{1}{-}1C^{Cu}{\cdot}1C^{Fe}_{-1}(\overset{2}{-}R_1)$
Andes	$1C{\cdot}1T_{-1}$
Britannia	$2T\overset{1}{-}R{\cdot}2_{-R}{\cdot}2_8(\overset{2}{-}1_{-R}\,1T_{-7})\overset{3}{-}1C^{Cu}_R(\overset{5}{-}1C^{Fe}_5)(\overset{6}{-}1C^{Fe}_5)$
Bunker Hill and Sullivan	$2_{-1}{\cdot}2T_{-3}\overset{1}{-}1{\cdot}R_1(\overset{3}{-}1_3)\overset{5}{-}1_5(\overset{6}{-}1_6)\overset{7}{-}1C^{Pb}_7(\overset{8}{-}1C^{Zn}_8)$
Calumet and Hecla	$2T_{-1}\overset{1}{-}1_1\overset{3}{-}1C_3$
Climax	$2T_{-1}\overset{1}{-}R{\cdot}2T_{-3}\overset{3}{-}1_3\overset{5}{-}1_5\overset{6}{-}1C^{Mo}_6$
Consol. M.&S.	$4T\overset{1}{-}1{\cdot}(\overset{2}{-})R_1(\overset{3}{-}1{\cdot}R'{\cdot}1_{-6}{\cdot}1T_{-R'})(\overset{4}{-}R')\overset{5}{-}1C^{Pb}_5(\overset{6}{-}1C^{Zn}_6)$
Eagle-Picher	$3T_{-2}\overset{1}{-}1{\cdot}(\overset{2}{-})R_1\overset{4}{-}R'{\cdot}1C^{Pb}{\cdot}1_{-5}{\cdot}1C^{Zn}_{-R'}$
Nevada Cons. (McGill)	$G{\cdot}1{\cdot}R{\cdot}2T_{-G}\overset{1,2}{-}1_G\overset{4}{-}1C_G$
Magma	$1C{\cdot}1T_{-1}$
Mt. Lyell	$2_{-1}{\cdot}1_{-1}{\cdot}1_{-3}{\cdot}DsT{\cdot}BC^{Au}{\cdot}2T_{-5}\overset{1}{-}1_1(\overset{5}{-}1_5)\overset{7}{-}1C^{Cu}_7(\overset{8}{-}1C^{Fe}_5)$
Matahambre	$2T_{-1}\overset{1}{-}1_1\overset{3}{-}1C_1$
Miami	$G{\cdot}2T_{-G}\overset{1}{-}R{\cdot}2_{-R,G}\overset{3}{-}1C_R$
Midvale	$1C^{Pb}{\cdot}1_{-1}{\cdot}1C^{Zn}{\cdot}1_{-3}{\cdot}2C^{Fe}{\cdot}1C^{Fe}T\overset{5}{-}R_3$
Noranda	$1C^{Cu}{\cdot}2_{-1}{\cdot}R{\cdot}Ae{\cdot}1C^{Cu}{\cdot}1_{-R}{\cdot}2_{-6}{\cdot}DsT{\cdot}R'{\cdot}Ae'{\cdot}1C^{Fe}{\cdot}2T_{-R'}$ $\overset{2}{-}1C^{Cu}_1(\overset{6}{-}2_{-12,6})(\overset{9}{-}2C^{Fe}_{R'})\overset{12}{-}1_{12}\overset{15}{-}Ae''{\cdot}1C^{Fe}{\cdot}1_{-Ae''}{\cdot}D'sT{\cdot}R''_{Ae''}$

Smelting, a second product from an earlier run joins the stream in a subsequent run on an earlier product, that fact may be indicated as shown in the Consolidated symbol by the first and third parentheses. The first parenthesis ($\frac{2}{\ }$) and the period preceding it indicate that the feed to the immediately following Stage R is the underflow from the immediately preceding flotation stage and the overflow from flotation Stage 2, which is the second stage on the primary run. The third parenthesis indicates that sidestream from flotation Stage 4, being the fourth on the primary run, goes to the regrind unit R′ which takes the underflow from the first stage of zinc cleaning.

The specific stage number of any given flotation stage in a plant symbol is readily obtained by summing all of the preceding full-type numerals and adding one. Thus in the Mount Lyell symbol, the specific number of the stage in the first parenthesis ($\frac{5}{\ }1_5$) is 8.

Interpretation of plant symbols is best learned by visualizing them in the form shown in Table III, in which the symbols of Table II are repeated, but so spaced horizontally as to bring the runs on corresponding products in the same vertical columns. Plants are also herein grouped according to the valuable metal sought, i.e. copper from Ajo to Miami inclusive, lead-zinc from Bunker Hill to Midvale, and gold in pyritic copper at Noranda and Mount Lyell. Climax is molybdenum. Examining the symbols thus, the identity of Magma and Andes, the substantial identity of Calumet & Hecla and Matahambre, the similarity of Bunker Hill and Consolidated (with one more cleaning at Bunker Hill), and the marked difference therefrom of Midvale become apparent immediately. The predominance of two roughing stages per metal for base metals, and the multiplication of stages in the primary run

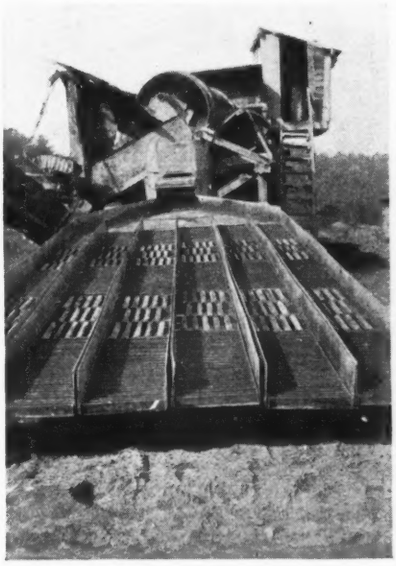
Table III—Flotation Flowsheets of Table II Spaced so as to Bring Runs on Corresponding Products Into Same Columns (Plants here are grouped according to valuable metal sought)

Mill	1 Run on primary pulp	2 Source of primary middling	3 Run on primary middling	4 Source of secondary middling	5 Run on secondary middling	6 Source of third middling	7 Run on third middling	8 Source of fourth middling	9 Run on fourth middling
Ajo	$1T$	$\frac{1}{\ }$	$1C \cdot R \cdot 2T_{-3}$	$\frac{3}{\ }$	$1C_3$				
Aldermac	$2T$	$\frac{1}{\ }$ $\frac{2}{\ }$	$1C^{Cu} \cdot 1C^{Fe}_{-1}$ R_1						
Andes	$1C \cdot 1T_{-1}$								
Britannia	$2T$	$\frac{1}{\ }$ $\frac{2}{\ }$	$R \cdot 2_{-R} \cdot 2_8$ $1_{-R} \cdot 1T_{-7}$	$\frac{3}{\ }$ $\frac{5}{\ }$ $\frac{6}{\ }$	$1C^{Cu}_R$ $1C^{Fe}_5$ $1C^{Fe}_5$				
Calumet and Hecla	$2T_{-1}$	$\frac{1}{\ }$	1_1	$\frac{3}{\ }$	$1C_3$				
Nevada Cons. (McGill)	$G \cdot 1 \cdot R \cdot 2T_{-G}$	$\frac{1,2}{\ }$	1_G	$\frac{4}{\ }$	$1C_G$				
Magma	$1C \cdot 1T_{-1}$								
Matahambre	$2T_{-1}$	$\frac{1}{\ }$	1_1	$\frac{3}{\ }$	$1C_1$				
Miami	$G \cdot 2T_{-G}$	$\frac{1}{\ }$	$R \cdot 2_{-R,G}$	$\frac{3}{\ }$	$1C_R$				
Bunker Hill and Sullivan	$2_{-1} \cdot 2T_{-3}$	$\frac{1}{\ }$ $\frac{3}{\ }$	$1 \cdot R_1$ 1_3	$\frac{5}{\ }$ $\frac{6}{\ }$	1_5 1_6	$\frac{7}{\ }$ $\frac{8}{\ }$	$1C^{Pb}_7$ $1C^{Zn}_8$		
Consol. M. & S.	$4T$	$\frac{1}{4}$ $\frac{3}{\ }$ $\frac{4}{\ }$	$1 \cdot (\frac{2}{\ }) R_1$ $1 \cdot R' \cdot 1_{-6} \cdot 1T_{-R'}$ R'	$\frac{5}{\ }$ $\frac{6}{\ }$	$1C^{Pb}_5$ $1C^{Zn}_6$				
Eagle-Picher	$3T_{-2}$	$\frac{1}{\ }$	$1 \cdot (\frac{2}{\ }) R_1$	$\frac{4}{\ }$	$R' \cdot 1C^{Pb} \cdot 1_{-5} \cdot 1C^{Zn}_{-R'}$				
Midvale	$1C^{Pb} \cdot 1_{-1} \cdot 1C^{Zn} \cdot 1_{-3} \cdot 2C^{Fe} \cdot 1C^{FeT}$	$\frac{5}{\ }$	R_3						
Mt. Lyell	$2_{-1} \cdot 1_{-1} \cdot 1_{-3} \cdot DsT \cdot BC^{Au} \cdot 2T_{-5}$	$\frac{1}{\ }$ $\frac{5}{\ }$	1_1 1_5	$\frac{7}{\ }$ $\frac{8}{\ }$	$1C^{Cu}_7$ $1C^{Fe}_5$				
Noranda	$1C^{Cu} \cdot 2_{-1} \cdot R \cdot Ae \cdot 1C^{Cu} \cdot 1_{-R} \cdot 2_{-6} \cdot DsT \cdot R' \cdot Ae' \cdot 1C^{Fe} \cdot 2T_{-R'}$	$\frac{2}{\ }$ $\frac{6}{\ }$ $\frac{9}{\ }$	$1C^{Cu}_1$ $2_{-12,6}$ $1C^{Fe}_{R'}$	$\frac{12}{\ }$	1_{12}	$\frac{15}{\ }$	$Ae'' \cdot 1C^{Fe} \cdot 1_{-Ae''} \cdot D'sT \cdot R''_{Ae''}$		
Climax	$2T_{-1}$	$\frac{1}{\ }$	$R \cdot 2T_{-3}$	$\frac{3}{\ }$	1_3	$\frac{5}{\ }$	1_5	$\frac{6}{\ }$	$1C^{Mo}_6$

when gold is the object, are brought out clearly. Climax shows similar multiplication of cleaning stages when high-grade concentrate is the desideratum; Andes and Magma demonstrate how the millman's problem is simplified when a high-iron concentrate is acceptable to the smelter. Discharge of a tailing from the primary middling run after regrind is indicated by the T in the third column of Ajo, Consolidated, Britannia, and Climax. The prevalence of double cleaning is shown by the predominance of entries in the fifth column. Predominance of one-stage counterflow of cleaner tailing is apparent from the frequent appearance of the form $\frac{x}{-}Y_x$ in columns 2–3, 4–5 and 6–7.

Regrinding effected in the primary middling circuit appears as universal in the lead-zinc plants symbolized, but much less frequently in the copper plants.

I am at present engaged in revision of the "Handbook of Ore Dressing" and contemplate the use of this method of symbolic representation therein for recording and analyzing flotation-pulp routings. Comments thereon from the men who will use the book, either by publication or private communication, will be much appreciated.



Arrangement of sluice boxes and riffles at the property of the Ferey Mining Company, in White County, Ga.

Placer Mining For Gold Near Dahlonega, Ga.

The Ferey Mining Company has been working ground on Dukes Creek for the past three years

Garland Peyton

Director, Division of Mines, Mining, and Geology, Department of Natural Resources, Atlanta, Ga.

FOR more than three years the Ferey Mining Company has been reworking old placer deposits along Dukes Creek, near Dahlonega, Ga. During this period it has been responsible for approximately 80 per cent of the gold produced in this State.

The mining and washing equipment consists of a dragline excavator employing a 1-cu.yd. bucket and a portable washing plant. The hopper discharges into a revolving trommel, the oversize going to a belt stacker. Undersize, with 1,000 gal. of water per minute, passes through a single sluice box to a distributing pan with guides which feed the concentrates and water evenly to a battery of six sluice boxes, each being 14 in. wide and 20 ft. long. Each box has five sections of riffles, 48 in. long, three being of $\frac{1}{4}$-in. flat iron and $1\frac{1}{2}$ in. high set at an angle of 20 deg. Alternating with these are two sections of California-type riffles set in the same type of frame but constructed of $1\frac{1}{2}$-in. round turned hardwood.

It has been observed that, by alternating these different types of riffles, the tendency of the sand and concentrates to pack between riffles has been lessened. The total volume of concentrates, about 4 cu.yd., obtained in the six parallel boxes is the same as was produced in the single box. This new arrangement has proved effective in catching fine gold formerly lost. It is rare to find gold in the lower third of a box.

Concentrates are moved to a clean-up plant using 24-in. revolving screen and bowl amalgamation, this being the only place where mercury is used. Two 3-in. centrifugal suction pumps, powered by a 50-hp. International kerosene engine, are used to keep the pits dry. Power for the screen is supplied by a 40-hp. kerosene engine. The water line feeds a distributor drum having two 4-in. lines, one perforated with $\frac{1}{2}$-in. openings for spraying the gravel in the screen, and the other for feeding water to material in hopper.

Overburden is stripped off and stacked to one side of the pit being worked, each pit being approximately 70x90 ft. with 3 to 6 ft. of overburden and a similar depth of gravel. After the overburden has been removed from part of the pit, the same dragline is employed to excavate the gravel and deliver it to the hopper. As a rule, two pits are worked before a clean-up is made. The gravel is dumped back into the part of the pit already excavated. Before the operation is abandoned, the top soil will be replaced by a bulldozer.

From 300 to 500 cu.yd. is handled in ten hours. Average gold content of the gravel, from grass roots to bed rock, is 25c. per cubic yard. Recovery is 90 per cent. Water is pumped from Dukes Creek through an 8-in. spiral pipe. Eight men, including laborers (colored), one foreman and panner, and one superintendent, are employed. T. J. Stephenson, of Cleveland, Ga., is superintendent and Sam P. Cronheim, William-Oliver Building, Atlanta, Ga., is vice-president of the company.

The Recovery of Lode Gold in Jigs

Certain testing procedure for determining the jigging characteristics of an ore is proposed

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GRAVITY concentration of gold is a process that was known to primitive man and has been improved by the modern mining engineer only by its adaptation to a high rate of production. The jig is the foremost machine yet developed to use this process. It is now being used successfully in many gold mills to recover relatively coarse free gold as a high-grade concentrate. In a few operations jigs are used to produce a waste product or finished tailing, lessening the amount of ore treated in subsequent processes.

As yet, no standard method of testing the jigging characteristics of a gold ore has been proposed, and often it has been difficult to evaluate the effectiveness of a jig in a flowsheet without making a test run with a full-size jig and a large volume of ore.

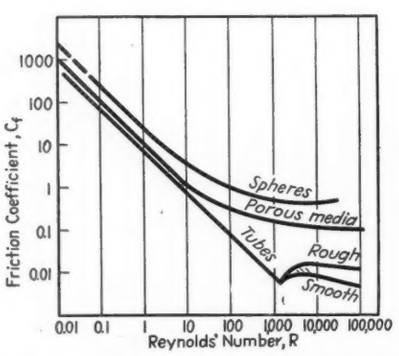


Fig. 1 . . . Characteristic curves for spheres in water, water through porous media, and water through tubes. After Bramel,* McCurdy,† and Poland §

* Bramel, H. R.: "The Hydrodynamics of Spheres and Particles in Free Motion," unpublished thesis, Stanford University, Department of Mining Engineering. 1939

† McCurdy, R. C.: "A Study of the Petroleum Drainage Problem." Unpublished thesis, Stanford University, Department of Mining Engineering. 1933.

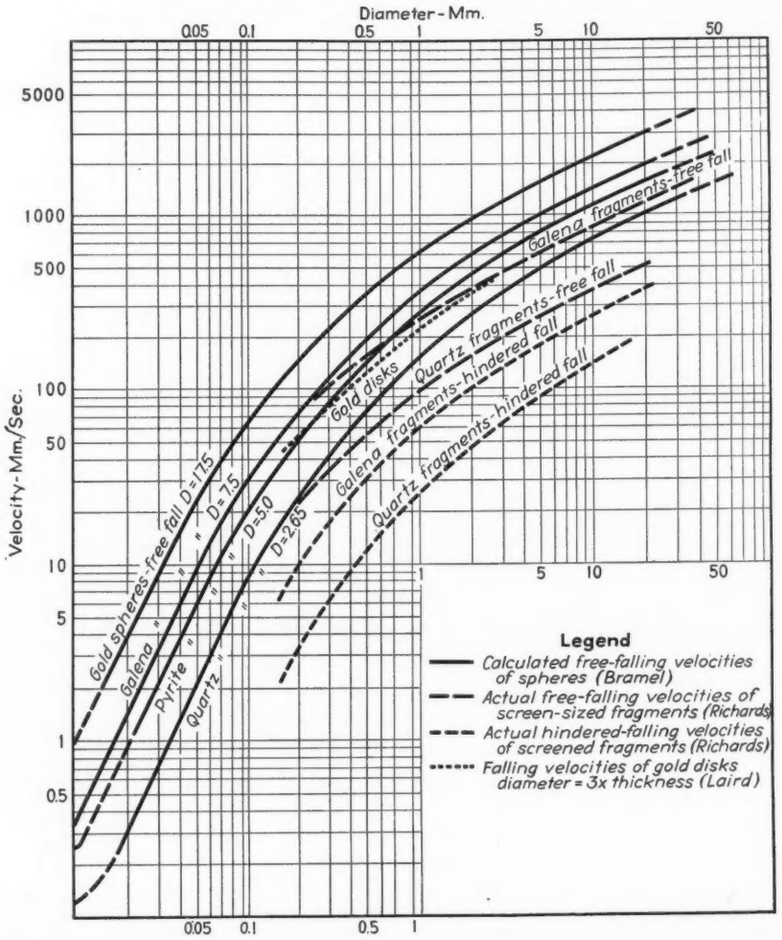
§ Tolman, C. F. and Poland, J. F.: "Groundwater," Chapter VIII, p. 197. McGraw-Hill Book Co., New York, 1938.

The purpose of this paper is to develop a standard test method for jigging similar to those methods now used for cyanidation, amalgamation, and flotation when testing 10- to 100-lb. samples.

To develop a test, the theory of jigging action was reviewed to establish the most important physical factors acting to make a separation; and California mines were visited to gain a better understanding of mill conditions, the products desired, and the usual position of jigs in the flowsheet.

Principles of Jig Action—As now used for gold ores, the jig is a hydrodynamic concentrator which separates minerals according to density and size in a bed of ore supported on a screen in a rising, pulsating column

Fig. 2 . . . A chart for obtaining terminal velocities of mineral particles in water



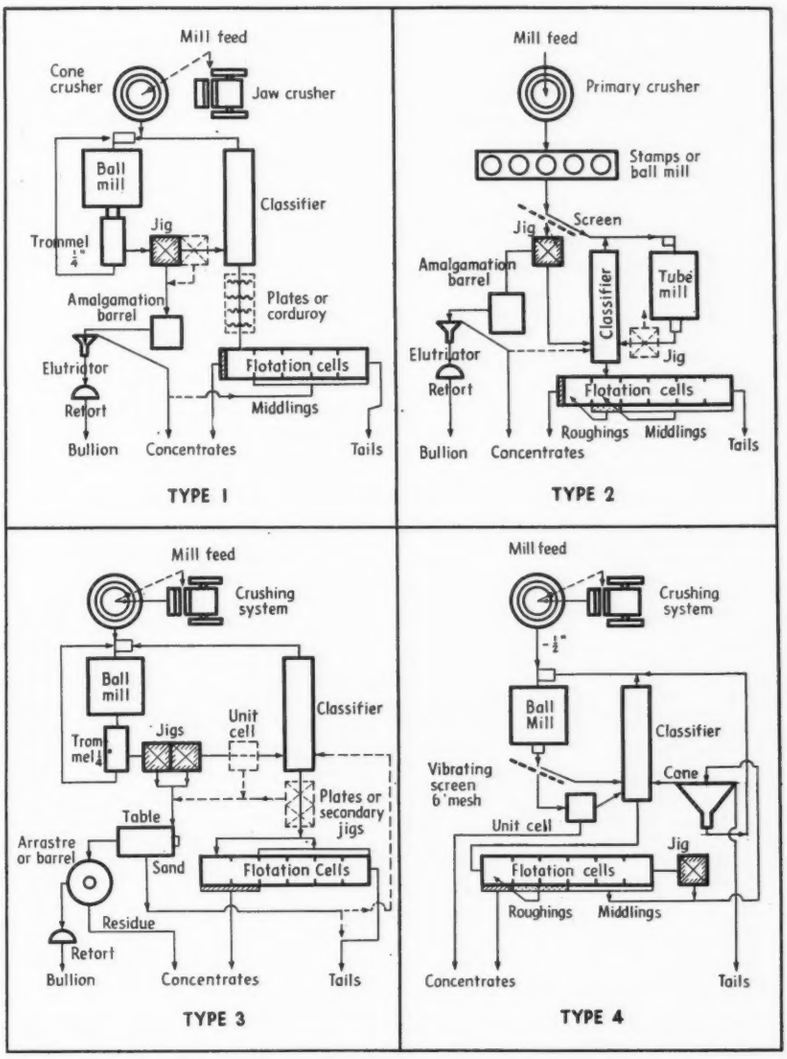


Fig. 3 . . . Typical flowsheets showing the use of jigs in connection with types of concentration equipment

of water. The mineral particles in the ore are separated by the screening action of the bed.

Heretofore five types of particle action have been studied to explain the separation taking place in a jig: (1) Free fall, (2) Interstitial fall, (3) Hindered fall, (4) Initial acceleration, (5) Stratification.[1,2,3,4,5] Of these hindered fall has come to be considered the most important. But the best key to understanding the behavior of particles in water is the concept of mechanical similarity.

Reynolds criterion,[6] $R = \rho DV/\mu$ is a dimensionless ratio which may be considered as expressing the geometric distribution of normal and tangential forces existing in the neighborhood of a solid-liquid surface. It may be plotted against various quantities. The drag or fluid resistance effective on the surface of a particle is the most important quantity. It is compared to the drag force on some arbitrary surface used as a standard of comparison to give another dimensionless ratio, friction coefficient, $C_f = \frac{F_f}{\frac{1}{2}\rho A V^2}$. The term C_f indicates the change in fluid resistance as the Reynolds number, R, is changed. Plotting Reynolds number against friction coefficient gives a curve characteristic for a particular geometrical shape and type of motion.

The characteristic curves for spheres in water, water through porous media, and water through tubes are indicated in Fig. 1. All three curves start with a slope of -1 in the zone of viscous flow, but turbulence starts at different points on each curve. The beginning of turbulent flow is indicated by the departure from the -1 slope. Different densities of particle and different kinematic viscosities of fluid $\left(\nu = \frac{\mu}{\rho}\right)$ give the same characteristic curve for a particular type of motion. We would therefore expect curves expressing relation of size to terminal velocity to be similar for all densities and viscosities and to show incipient turbulence at a point indicated by the Reynolds number curve. Fig. 2 shows curves for obtaining terminal velocities in water.

These curves have the same shape regardless of density, shape of particle, and free or hindered state of fall. Hindered fall appears to increase the kinematic viscosity slightly and the irregular shape of mineral fragments seems to increase the effect of turbulence in decreasing terminal velocity in the larger sizes.

Separation takes place in a jig while the minerals are submerged and hence must be governed by the principles of hydrodynamics suggested graphically in Fig. 2. Hindered settling is the condition of that stratum of the jig bed in which most of the separation takes place. The sifting action of the screen and bed (stratification) allows the capture of the heavy minerals and the exclusion of coarse gangue minerals after these two have been separated. Flow of hutch water and speed of operation may be proportioned to give greatest advantage to these two processes in the desired range of particle sizes. Therefore any test method should try to approximate the effect of hindered settling and sifting combined; or should make use of some physical process which makes a similar separation by size and density.

Performance of Jigs in California Mills—Only a few years ago jigs were a curiosity in gold mills, but now (1939) at least 30 mills in California use them in lode operations. The theory that gold occurs in only two ways—as native gold and in tellurides, and never in solid solutions—is becoming well accepted.[7,8,9,10] This would explain why a closed-circuit installation will produce a high-grade concentrate in which gold occurs as free particles; or why it is sometimes possible to use a jig as a primary separa-

[1] Rittinger, P. R.: "Lehrbuch der Aufbereitungskunde." Ernst and Korn, Berlin, 1867.

[2] Munroe, H. S.: "The English versus the Continental System of Jigging." Trans. A.I.M.E., Vol. 17, p. 637. 1889.

[3] Richards, R. H.: "Close Sizing Before Jigging." Trans. A.I.M.E., Vol. 24, p. 433. 1894.

[4] Simons, Theodore.: "Basic Principles of Gravity Concentration." Trans. A.I.M.E., Vol. 68, p. 431. 1923.

[5] Fahrenwald, A. W.: "The Theory of Stratification and Its Application in Ore Dressing." *Mining and Metallurgy*, Vol. 7, p. 437. Oct. 1926.

[6] R = Reynolds number
ρ = density of fluid
D = diameter of tube or body
V = velocity of fluid or body
ν = viscosity of fluid
C_f = drag coefficient
F_f = force of drag
A = area of cross section
ν = kinematic viscosity

[7] Warren, H. V. and Cummings, J. M.: "Textural Relations in Gold Ores of British Columbia." Mining Technology, March 1937, p. 1., A.I.M.E.

[8] Haycock, M. H.: Investigations in Ore Dressing and Metallurgy, Mines Branch, Dept. of Mines, Canada. 1934, 1935, 1936.

[9] Head, R. E.: "Form and Occurrence of Gold in Pyrite." U.S.B.M., R. I. 3226, p. 27. March 1934.

[10] Knopf, A.: "The Mother Lode System of California." U.S.G.S. Prof. Paper 157, p. 37. Washington.

tion process to produce low-grade tailings from either a closed or open circuit. Table I will indicate characteristic performances.

Only rarely can jigs be used as the only concentrators. They are usually followed by flotation, cyanidation, blankets, amalgamating plates, cones or any combination of these to recover a part of the remaining values. But the jig increases the efficiency of other processes and adds to net profit in several ways. Typical flowsheets are shown in Fig. 3.

In mills using flotation, the chief advantage of producing and treating a jig concentrate is the easy recovery of gold as amalgam or bullion rather than in a concentrate which must bear the cost of smelting and shipping charges. The effective price at the mine for gold in a concentrate may be as low as $28 an ounce. An average effective value at the mine for bullion is $34.80 an ounce. Most of the difference is profit on that gold recovered in the jig.

The jig also tends to improve the feed to the flotation circuit. Great fluctuation in the mill heads will produce only mild fluctuation in the value of the classifier overflow. Surges of gold and sulphide particles over the classifier lip will be practically eliminated. Consequently, reagents may be fed at a constant and more economical rate, and less attendance is required on flotation units. The time and reagent concentration required to obtain a certain recovery depends on the grade of ore fed to the circuit. Hence the previous removal of a considerable amount of the gold reduces the necessary size of plant and its cost of operation. A study of cyanidation and flotation tailings has shown that surface contamination on gold particles is often responsible for a big tailing loss.[11] The surface characteristics of the gold do not affect its recovery by gravity concentration. It may be recovered from the concentrate by treating with acid or alkaline solution to dissolve the coating, or by grinding to scratch the surface, previous to amalgamation. Most operators report a reduction in average tailings assay after the installation of jigs.

In cyanidation plants, most of the advantages mentioned for flotation plants also apply. Grinding in cyanide solution is permissible with jigs in the circuit; it is not when using plate amalgamation or unit cell flotation to recover the coarse gold. If there is a possibility of cyaniding only concentrates, then carbonaceous matter, clay gangue, and other non-metallic substances deleterious to cyanidation will be eliminated from the concentrate.

There are, of course, several factors which sometimes preclude the use of jigs. With coarse ore it may be necessary to introduce more water into the hutch than can be successfully handled by the classifier or other units following the jig. The installation of dewatering cones is expensive because it usually requires operation of pumps to overcome loss of head in the cones. It may be difficult to secure a large supply of water at a steady head. When practically all of the gold occurs as particles finer than 200 mesh it would be extremely difficult to make a successful recovery of these in a jig. In such cases, blankets, a unit cell, or amalgamation plates should be used to recover fine free gold.

Proposed Laboratory Test for Jigging—Since hindered settling and sifting seem to produce jig action, one would expect a test method using these features to predict jig results better than others. A method of panning using a continuous flow of water over the ore was found to give the best results, but heavy liquid separations, making an almost perfect specific gravity separation, were also found helpful. Most

Table I—Performance of Jigs in California Gold Mills

Column — **Legend**

(1) O Operating P Planned I Idle (as of 1939)

(2) V Free gold in quartz
S Gold associated with mixed sulphides
Py Gold associated with pyrite
Ga Gold associated with galena
Ox Oxidized or clayey ore
T Tailings or old dumps

(3) B Bendelari diaphragm jig (F.N. Bendelari)
D Denver mineral jig (Denver Equipment Co.)
H Pan American hydraulic pulsator jig (Pan American Engineering Co.)
L Jig of local manufacture (usually Harz type)
M Miners Foundry diaphragm jig (Nevada City Foundry)
P Pan American placer type jig (Pan American Engineering Co.)
S Southwestern hydraulic diaphragm jig. (Southwestern Engineering Co.)

(4) Recovery as bullion from jig hutch product except as noted.

(5) and (8) Ratio and capacity are based on New Feed. Circulating load varies from 100% to 700% in Types 1 and 3.

(6) See Figs. 3 and 4

Mill No.	(1) Present Activity	(2) Type of Ore	(3) Name of Jig	(4) Recovery as Bullion, %	(5) Ratio of Concentration (New Feed)	(6) Type of Flow-sheet	(7) Mill Capacity Tons/Day	(8) Jig Capacity Tons/ft. Day
1	O	S	P	50–70	137:1	1	25	25
2	O	S	L	5–10	....	2	220	100
3	O	Ox	M	69.8 (a)	50:1	1	75	30
4	O	S	M	50	500:1	1	120	36
5	I	T	L	.....	.....	2	100	.....
6	O	S	3P	70	100:1	1	900	36
7	O	S	L	7.7 (a) (b)	730:1	1 (m)	90	45
8	O	S	B	0.5–1.0 (c)	8:1	4	290	24
9	O	Py	M	50–70	400:1	1	100	25
10	O	Py	M	60	430:1	2	75	20
11	O	S	B	75	120:1	1	150 (d)	6 (d)
12	O	S	M	5–8	330:1	3	125	31
13	O	Py	B	60–85	100:1	1	100	24
14	O	V	D	90	250:1	1	25	19
15	O	Py	M	60–70	960:1	1	60	27
16	O	Py	B	54	200:1 (f)	3	288	16
17	I	Ox	B	.....	.....	3	300	33
18	O	S	B, H	(b)	1,500:1 (f)	3	200	25
19	O	S	B	66.9 (a)	200:1 (a) (f)	3	145	24
20	I	Ga	L	.....	.....	1	30	39
21	I	Ox	4P	(l)	.....	3 (m)	1,000	25
22	I	Ox	H	20–30	4,000:1 (f)	3	150	38
23	P	S	H, S	30 (g)	100:1	3	220	55
24	I	S	B	(l)	.....	3 (m)	120	26
25	O	Py	B	85	75:1 250:1 (f)	3	75	16
26	O	S	D	10–20	500:1	1	25	9
27	O	V	P	85–90	130:1	1	24 (h)	24
28	O	S	P	60–75	40:1	1	24 (h)	24
29	O	S	L	10	750:1	1	150	100
30	O	S	H	46 (a) (b)	1,000:1	1	150	38
31	O	Ox, T	2P	10–30	20:1 2,200:1 (f)	2, 3 (m)	1,100	92
32	I	D		.....	.....	.....	.....	.....
33	O	T	B	19:1 (a) (k)	200:1 (f)	3 (j)	200	21
34	I	Ox	B	.....	.....	.....	.....	.....
35	P	S	D	.....	.....	.....	.....	.....
36	P	S (i)	L	.....	.....	3 (m)	150	.....
37	I	Py	L	(b)	100:1	2	.....	.....

Notes

(a) Average for month preceding visit.
(b) Jig concentrates are shipped to a smelter.
(c) Per cent of heads value recovered from flotation tailings.
(d) Capacity to be increased to 300 tons a day.
(e) Gravel conglomerate is mined from an open pit, treated similarly to lode ore.
(f) Ratio for jig and table in combination.
(g) Table concentrate melted to form matte and shipped to a smelter.
(h) Mine usually operated only one or two shifts (8 to 16 tons).
(i) Major value of ore is in silver.
(j) Flowsheet includes flotation of primary slimes, cyanidation of sands, table middlings, and secondary slimes.
(k) Amalgamation residue is cyanided. 10.4% of bullion is amalgamation sponge.
(l) Jig concentrates treated by both amalgamation and cyanidation.
(m) Cyanidation replaces or assists flotation.

Table II—Heavy Liquids

Range of Specific Gravity	Heavy Liquid	Diluting or Washing Reagent	Method of Recovery
1.60 to 2.85	Bromoform ($CHBr_3$)	Alcohol	Shake with water to remove alcohol
2.85 to 2.95	Acetylene tetrabromide ($C_2H_2Br_4$)	Alcohol	Shake with water to remove alcohol
3.50 to 4.95	Thallous formate-malonate ($TlCHO_2 - TlC_2H_2O_2$)	Water	Distill gently to remove water

[11] Head, R. E.: "Physical Characteristics of Gold Lost in Tailings." T. P. 674, A.I.M.E., New York, 1936.

mills produce a small high-grade concentrate, and so it was necessary to use a method which could do this and at the same time give an estimate of the cleanest tailings which could be produced.

After making many different tests on ores from three California mines (the Dutch, Zeibright, and Sheepranch mines Nos. 37, 6, and 19 respectively in Table I) the testing system proposed here was developed. It should be applicable to any gold ore.

A sample of the ore to be tested should be secured at the point in the flowsheet where the jig will be used. If no decision has been made as to where or how to use a jig, a sample may be used which has been crushed to the minimum size practicable for the crusher at hand ($\frac{1}{4}$ to $\frac{3}{8}$ in). This sample is sized by screening into several fractions. A suggested screen scale is the one employing the ratio 4, e.g. 8-, 28-, 100-, and 325-mesh screens. This separation is to facilitate testing, but results from each size will indicate the size at which best jigging results are obtained.

Two pans are used for the panning operation; they are shown in Fig. 5. As both pans have recessed bottoms similar to a dinner plate, minerals

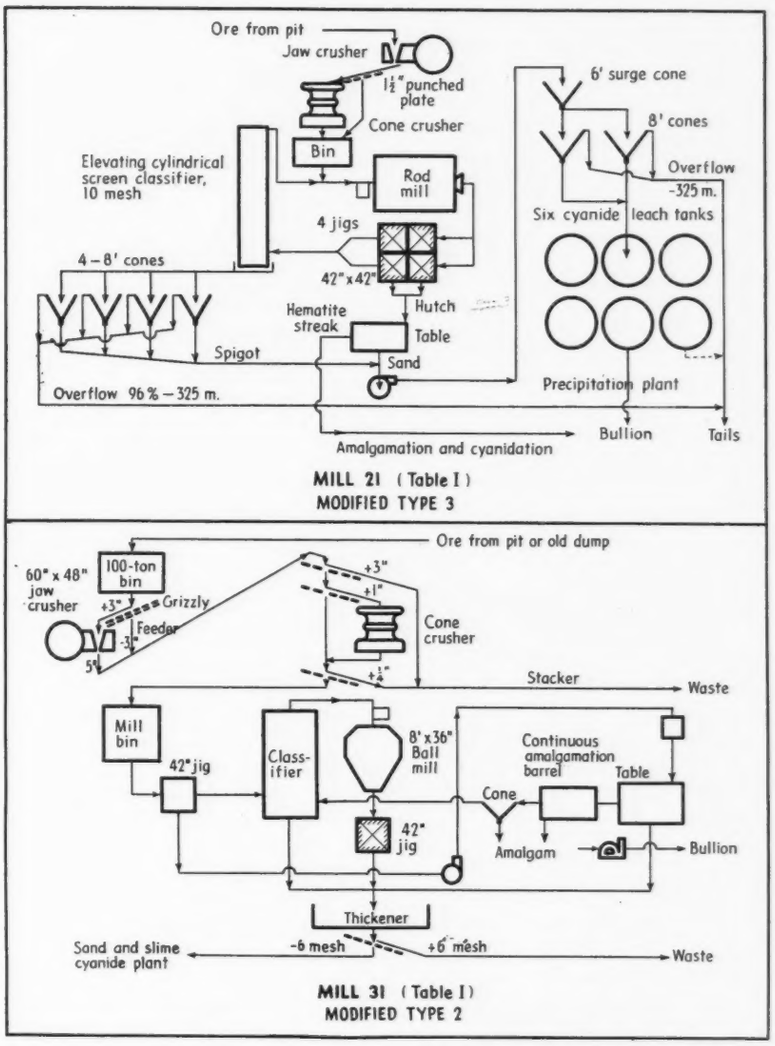
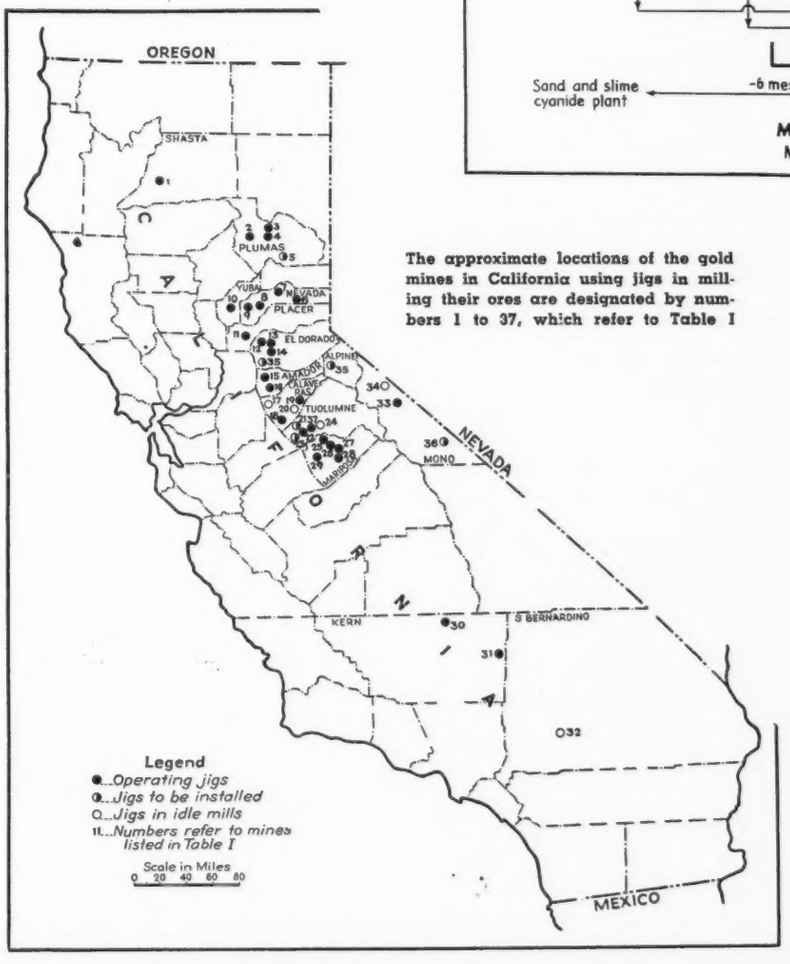


Fig. 4 . . . Two flowsheets for high capacity, in which jigs are employed with other concentrating equipment



The approximate locations of the gold mines in California using jigs in milling their ores are designated by numbers 1 to 37, which refer to Table I

must move over two edges before passing to the tailings basin. Hence the operation is called duplex panning. A nozzle is fastened to one edge of the pan and a rubber hose used to connect to some steady and adjustable water supply. The nozzle is held at the top of the pan when it is tilted down for operation. The amount of water required varies from 1 to 0.2 g.p.m., the amount being reduced as the amount of ore in the pan is reduced. During panning, the pan is shaken from side to side as in ordinary panning, and tilted so that a small amount of tailings will run over the edge into a tailings basin. Part of the water passes down and under, and then up through the ore; part merely passes over the top. If the flow of water is insufficient to remove the larger gangue minerals, the pan may be tilted back toward a level position until a small amount of water accumulates, and then let down periodically to produce a slight surge. Only one layer of minerals should be passing

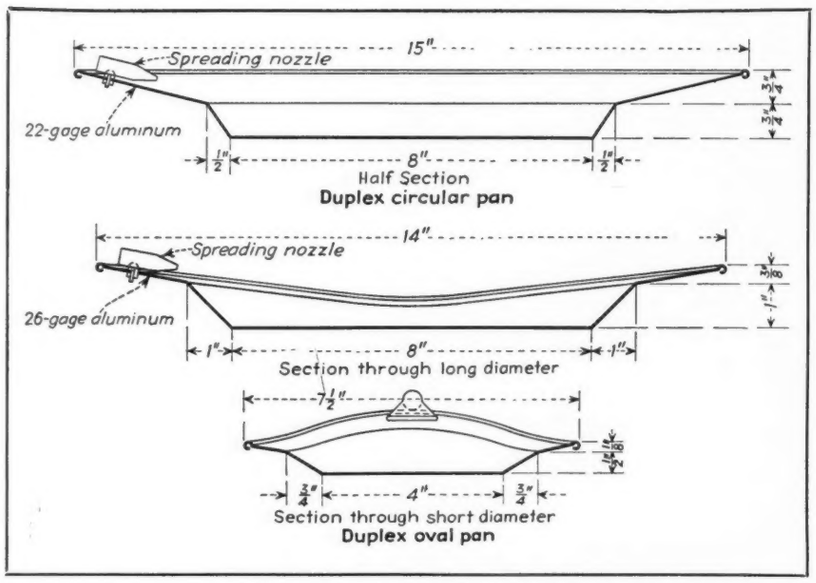


Fig. 5 . . . Two pans used for the panning operation in the laboratory test proposed by the author for jigging

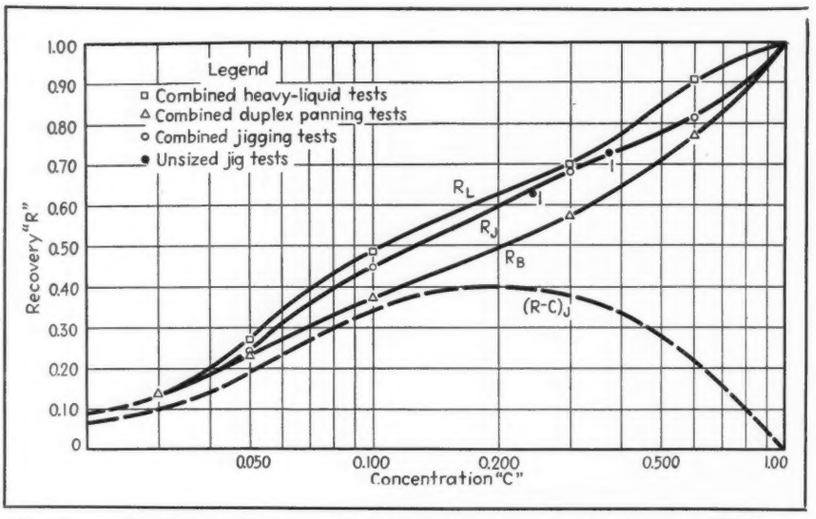


Fig. 6 . . . The curves above, representing combined tests on ore of Mill 37 (Table I), together with those given in Figs. 7 and 8, furnish examples of the best results obtained on three California ores

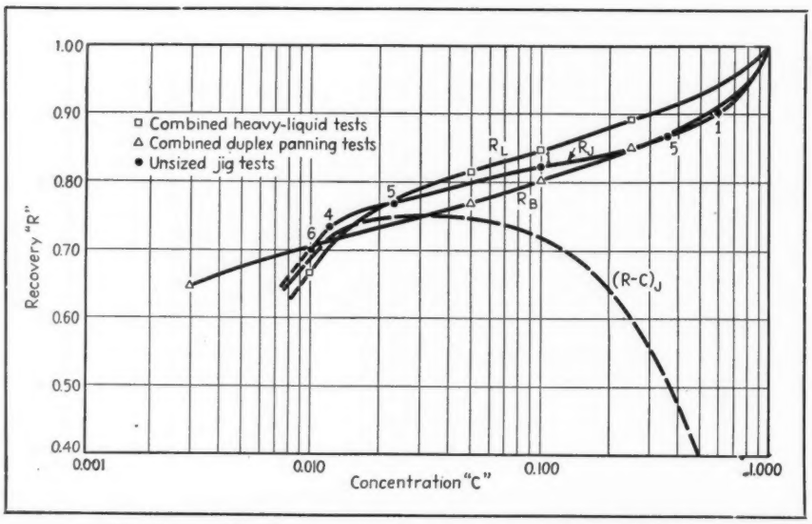


Fig. 7 . . . Results of combined tests on ore of Mill 6 (Table I)

over the edge at any moment. In this way, the operator has a chance to give all particles a cursory examination. If sulphides or other heavy minerals start coming over the edge, the pan is tilted back and shaken more thoroughly until only gangue is washed over when the pan is tilted down.

From 200 to 1,000 grams is taken from each size except the finest, and is panned in the duplex circular pan. When sulphides or ore minerals start passing over the edge of the pan despite careful shaking, the operation is temporarily stopped and the tailings are repanned; the second concentrate is added to the first. If this combined concentrate is small—less than 50 grams—it can be transferred to the smaller duplex oval pan. If not, another fraction should be removed until only 20 to 30 grams remain. The final concentrate is produced in the oval pan using only 0.3 to 0.2 g.p.m. of water and using as much care and time as patience allows. Tailings from these second and third operations are kept separate. The concentrate may be reduced until it appears that further panning might lose some gold. Each of the three or four products separated is dried and weighed and a sample of each assayed. If the amount of free gold which can be recovered from the concentrate is an important factor, the final product is given an amalgamation test. A concentrate of small weight (1 to 10 grams) is agitated in a flask or a larger concentrate is rolled in a bottle with 1 to 4 grams of mercury.

The value of each tailing removed determines a certain decimal recovery (R) in the remaining concentrate.

$$\left(R = \frac{\text{Total heads value} - \text{total tails value}}{\text{Total heads value}}\right)$$

The weight of the concentrate determines the decimal concentration (C).

$$\left(C = \frac{\text{Wt. of concentrate}}{\text{Wt. of sample}}\right)$$

From four products three pairs of values for R and C are obtained. These values are plotted to form an R_B curve for panning. Semi-logarithmic coordinates are used to separate the low range for C.

If possible, two or three heavy liquid separations should be made on each size to give values of R and C for plotting an R_L curve which will set an upper limit for jigging. Table II shows recommended reagents.

The bromoform and acetylene-tetrabromide may be used at room temperature but the thallous formate malonate, a mixture of equal parts by weight of the formate and malonate salts, must be used between 60 and 90 deg. C., unless it is used as a water solution of less specific gravity.

A 100-gram sample is sufficient for heavy liquid tests and may be used

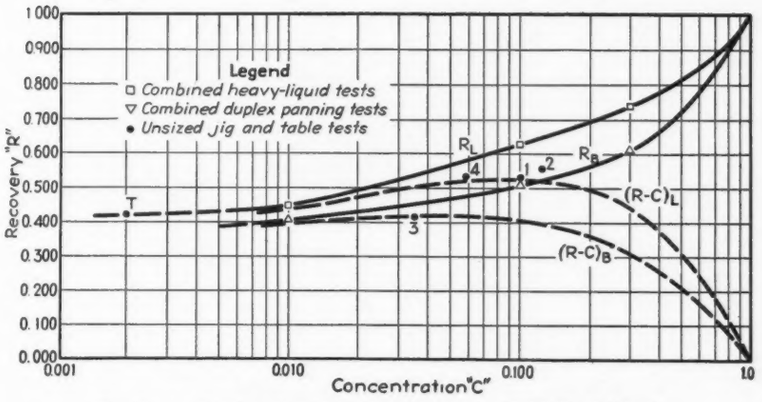


Fig. 8 . . . Results of combined tests on ore of Mill 19 (Table I)

with about 100 ml. in a 250-ml. beaker. After stirring, the ore which floats is removed with a spoon fashioned from copper screen. When all material that will float has been removed, the liquid is decanted from the concentrate remaining in the bottom of the beaker and both float and sink portions of the sample are washed several times with the washing reagent. In some cases the concentrate (sink product) from one test can be treated with a still heavier liquid, producing three products altogether to give two values for R and C.

The heavy-liquid products are treated in the same way as the products of the panning to give values of R and C which will give an R_L curve.

Jig results (R_J) in each size may be estimated to fall slightly above the R_B curve and below the R_L curve. If the jig is to be used on unsized materials, a mathematical combination of size curves may be drawn assuming little or no recovery in the size passing the last screen. Figs. 6, 7, and 8 are examples of the best results on the three California ores (Mill Nos. 37, 6, 19).

[12] Luyken, W. and Bierbrauer, E.; "Calculations in Ore Dressing." T. P. 214, A.I.M.E., New York, 1929.

An $(R-C)$ curve is drawn from the R_B curve by plotting several values of R less the C at that point. The maximum of this curve indicates the value of C which gives the greatest "absolute enrichment."[12] The possibility of producing a finished tailing is indicated by the first batch of tailings from the panning operation. If these were low enough in grade to be discarded, the jig could probably produce the same product in a large-scale operation.

In closed circuits the test results may be modified because most of the ore must be ground finer than a certain size before escaping from the circuit and only the portion of the fine gold released in the first pass through the grinding mill will be lost by the jig. The upper and lower limit of the size range is determined by the operating range of the classifier or screens. This limited size range may be tested in one batch for panning or heavy-liquid separation. The extraction indicated by the test gives an estimate of R, but a large circulating load may make it difficult to secure as low a value of C as the test indicates unless the installed jig capacity is 50 tons or less per square foot of bed area per day, based on circulating load rather than on feed.

(*To be concluded*)

New Course in Mineral Dressing
An Innovation in Engineering Education

Will aim at thorough grounding in mathematics, physics, and chemistry. It includes petroleum

A NEW PROGRAM of study in the field of mineral dressing, broadened to cover the preparation of all crude minerals for industrial use, including petroleum, will be introduced into the engineering curriculum of Columbia University next year under the direction of Prof. Arthur F. Taggart, according to a recent announcement. The innovation marks the first academic recognition granted to mineral dressing, hitherto concerned chiefly with the extraction of metals from metallic ores, as a profession in itself. The new curriculum will train men for the technological work which bridges the gap between the extraction of crude minerals from the earth and their preparation for consumer use.

Previously treated as a part of the training received in mining and metallurgy, mineral dressing will be made a special division of the curriculum leading to the degrees of bachelor of science and master of science in mineral dressing. In the past those who studied the subject were not given instruction in petroleum refining and it is also true that they received only a minimum amount of training in extractive metallurgy.

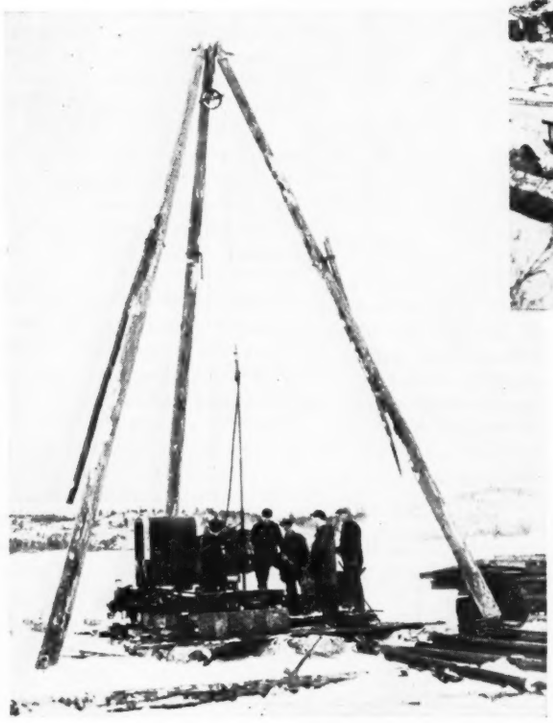
The new curriculum is reported to aim at a thorough grounding in mathematics, physics, and chemistry. It comprises further, as a foundation, the fundamental engineering subjects, the concepts of which are used continually by all engineers. Although established principles will be emphasized in the instruction, due consideration will be given to the empirical facts that have developed out of the recent practice of mineral dressing.

"If the course is criticized on the grounds that the scope of the subject matter is too broad for comprehension and absorption by the average student," says Professor Taggart, "encouragement can be found in comparing it with any good chemical engineering course. Here an equal range of unit processes and a greater range of materials and products are studied.

"Mineral dressing is the modern outgrowth of the ancient art of ore dressing, which comprised and was limited to the concentration of ores into smaller and more valuable bulks for metallurgical treatment. In the modern profession of mineral dressing, ore dressing is but one of three major parts, the other two being extractive metallurgy and petroleum refining. This is because the growth of modern technological science has made the mineral matter comprising the crust of the earth the source of supply for substantially all of the material demands of present-day civilization excepting only food, clothing, and a minor part of housing.

"The young graduate in mineral dressing will be equipped to enter, with substantially equal preparation, any one of the three general fields. There is a sufficient overlapping of training to make experience gained in one field useful in the others. The three divisions comprise a range of industrial activities of such breadth as to tend to absorb a part of the shock to employment that is imparted by economic depressions."

At a core-drilling station on the frozen surface of the lake. The rods are being withdrawn



Iron Resources

Recent views of the new development at

OCCURRENCES of iron-ore float on the shores of Steep Rock lake, in northwestern Ontario, suggested as long as 50 years ago the possibility that commercial deposits existed near by. Various investigations were made in the intervening period, and some test-pitting and drilling were done. In 1930, a dip-needle survey of the lake was made (*Trans.* C.I.M.M., Vol. XLII, 1939) and in 1937 a company was formed with the aid of Joseph Errington, of Toronto, to conduct a drilling campaign. The area was also studied by the Ontario Department of Mines in the same year. Geophysical surveys were made during the last two winters, and this work and that previously done have been checked by drilling conducted since then.

Steep Rock lake is 2½ miles north of the village

Leveling off a bit of rough ground at the camp site while plant construction was under way

Drilling holes in a blank drill bit at the Steep Rock shop, preparatory to setting the bort diamonds

The interior of the Steep Rock cookery

Looking southeast over the camp of Steep Rock Iron Mines, Ltd., on the shore of Steep Rock Lake, 2½ miles north of Atikokan, in northwestern Ontario. In the left background are the shaft, hoist room and blacksmith shop. In the foreground, from left to right are the cookery, office, and bunk house. Beneath the frozen lake beyond lies the body of hematite ore outlined by geophysical work and drilling during 1938-39

for Canada

Steep Rock Lake, in northwestern Ontario

of Atikokan, which is on the Canadian National Railway, 135 miles west of Port Arthur. Operations are being conducted by Steep Rock Iron Mines, Ltd., incorporated in February, 1939, with Mr. Errington as president. The company holds 160 claims, totaling 6,000 acres, and has built the camp shown. To date, 236 holes, totaling 65,000 ft., have been drilled. A shaft has been sunk and a station cut at the 800-ft. level, and late in March preparations were being made to start crosscutting. The ore is hematite of an indicated grade of 60 per cent plus, according to the management. The latter offers no estimate as to tonnage, but figures published in various Canadian papers make this large. A force of 100 men has been working and is to be increased this spring.

The sinking crew in the bottom of the new shaft on the Steep Rock property

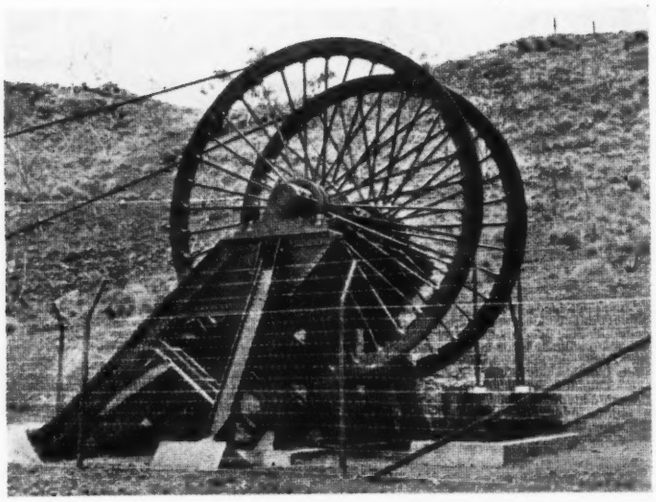
Adjusting the torsion balance used in the gravity survey. This is housed in an insulator hut, shown on the front cover

Taking observations with the vertical magnetometer. This and the two pictures at the right and above, respectively, indicate the varied geophysical methods employed

With the geophysical survey party from the University of Toronto. Electrical work is in progress. Left to right, the observation hut, the motor-driven generator, and, in the background, the current electrode being inserted through the ice into the water

Borehole Ropeways at Mount Isa

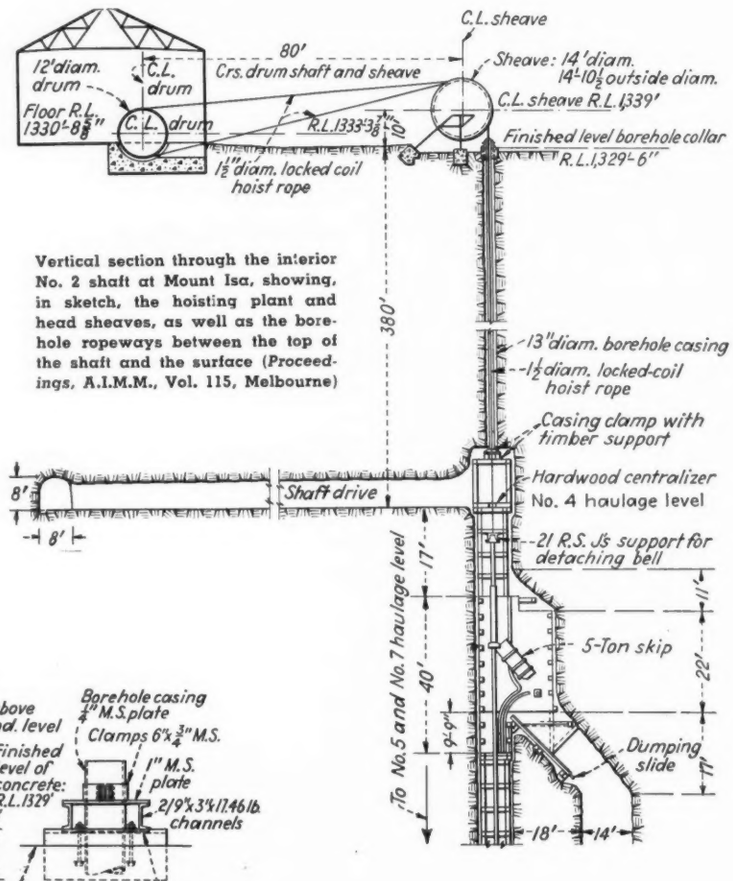
This development, reported from the State of Queensland, Australia, is regarded as unique



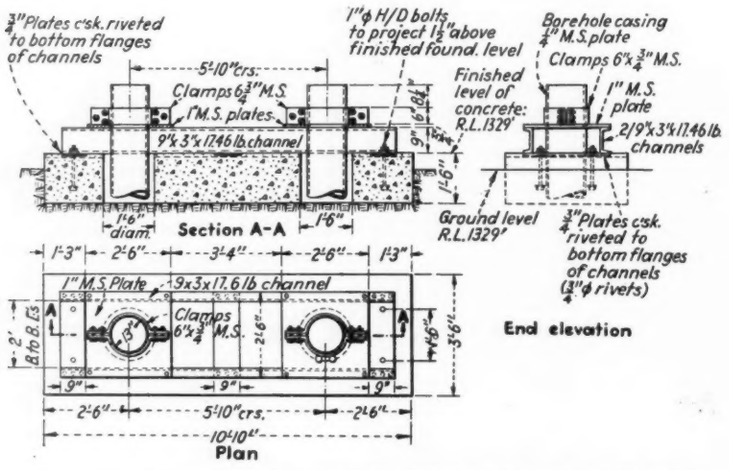
The head sheaves at the collar of the ropeway boreholes above Mount Isa's No. 2 shaft

USE OF BOREHOLES at the interior No. 2 shaft of Mount Isa Mines, Ltd., Queensland, Australia, to accommodate the hoisting ropes between the surface hoisting plant and the top of the shaft, which extends vertically from No. 4 haulage level (380 ft. below the surface) to a depth of 706 ft. below this level, is described by V. I. Mann, mine superintendent, in Vol. 115 (Sept. 1939) of the *Proceedings* of the Australasian Institute of Mining and Metallurgy, published at Melbourne. Mr. Mann believes this is a unique feature in hoisting installations. Accompany illustrations show the general scheme and the details of the borehole casing support, as well as the head sheaves at surface.

As a preliminary to adopting this scheme, observations were made at the Main Ore shaft to determine the amount of lashing or other movement of the rope while in motion during hoisting. Total deviation from the hanging position was found to be less than 3 in. both at the shaft collar, 115 ft. below the center of the sheave wheels, and at No. 4 level, 620 ft. below the sheaves at Main Ore shaft. Similar observations were made at other shafts. Assurances were received that the holes could be driven plumb. In subsequent drilling close check was kept on the vertical alignment. The two boreholes



Vertical section through the interior No. 2 shaft at Mount Isa, showing, in sketch, the hoisting plant and head sheaves, as well as the borehole ropeways between the top of the shaft and the surface (Proceedings, A.I.M.M., Vol. 115, Melbourne)



The casing clamps and their concrete foundations at the collar of the ropeway boreholes above No. 2 shaft (Proceedings, A.I.M.M., Vol. 115, Melbourne)

were drilled in 1937. They are 5 ft. 10 in. apart, center to center. Each was cased with 13-in. inside diameter casing made from ¼-in. steel plate. These casings were not perforated. Adjustment of casings to exact position at the collar was made after the sheave wheels and their supporting structure had been completed. The support design permitted adjustment of the plates under the casing clamp to desired position before final drilling and bolting to the channel frame. The lower ends of the casings, extending into the shaft opening at No. 4 level, were secured to shaft timbers.

Provision was made for installing an electric bell signal system by placing a 1¼-in. pipe conduit between bore and casing. This carried a flexible multicore cable.

Hoisting equipment consists of a double-drum, single-reduction geared hoist driven by a 510-hp. slipring induction motor, using 3,300-volt, 3-phase, 50-cycle current. Drums are 12 ft. in diameter by 3 ft. and grooved for 1½-in. rope. The usual safety features are provided. Ropes are 1½ in. in diameter and of locked-coil construction, and have a maximum breaking strength of 128 tons. Five-ton Kimberley-type skips are operated in balance at 1,000 ft. per minute. With this equipment the shaft was calculated to have a hoisting capacity of 3,600 tons in 21 hours' hoisting time for a maximum distance of 1,335 ft.

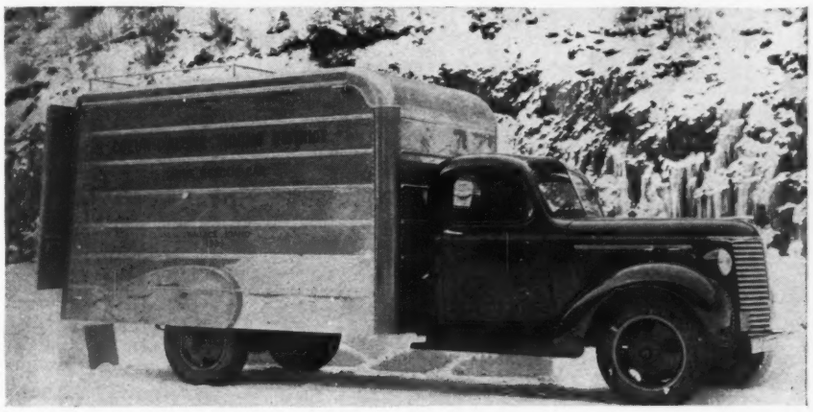
Shaft and equipment have been in operation since September, 1938. Up to May, 1939, 116,760 tons of ore, plus a lesser tonnage of rock, was hoisted from No. 3 level loading station to the storage bin above No. 5 level. All features of operation have been satisfactory. Ropes come into contact with the casings at irregular intervals, chiefly at the time rope tension is varied by application of brakes on slowing down. Such movement is in the nature of a vibration and disappears when ropes are running at full speed. To curb this action, centralizers of hard wood with a 3-in. diameter hole for rope opening were placed at the top of the shaft on No. 4 level. Their location is such that it minimizes lateral movement at a point approximately midway between the bottom of the borehole casings and the detaching bells. Contact of the ropes, while in motion, at either of these places might easily and quickly cause serious wear on the ropes. Up to the time of writing, examination of the ropes had failed to reveal damaging effects from the occasional contact with the casings.

The cost of the scheme, including equipment and installation costs plus current mine overhead charges, from surface to shaft depth of 181 ft. below No. 7 level (two 371-ft. bores and 706-ft. shaft), amounted to £72,-310.408.

Mine Rescue Work

in the Coeur d'Alenes

Operations in the district are safeguarded by provision of proper training and equipment



The truck ready for service. Its mobility is a great advantage in reaching mines not on a railroad

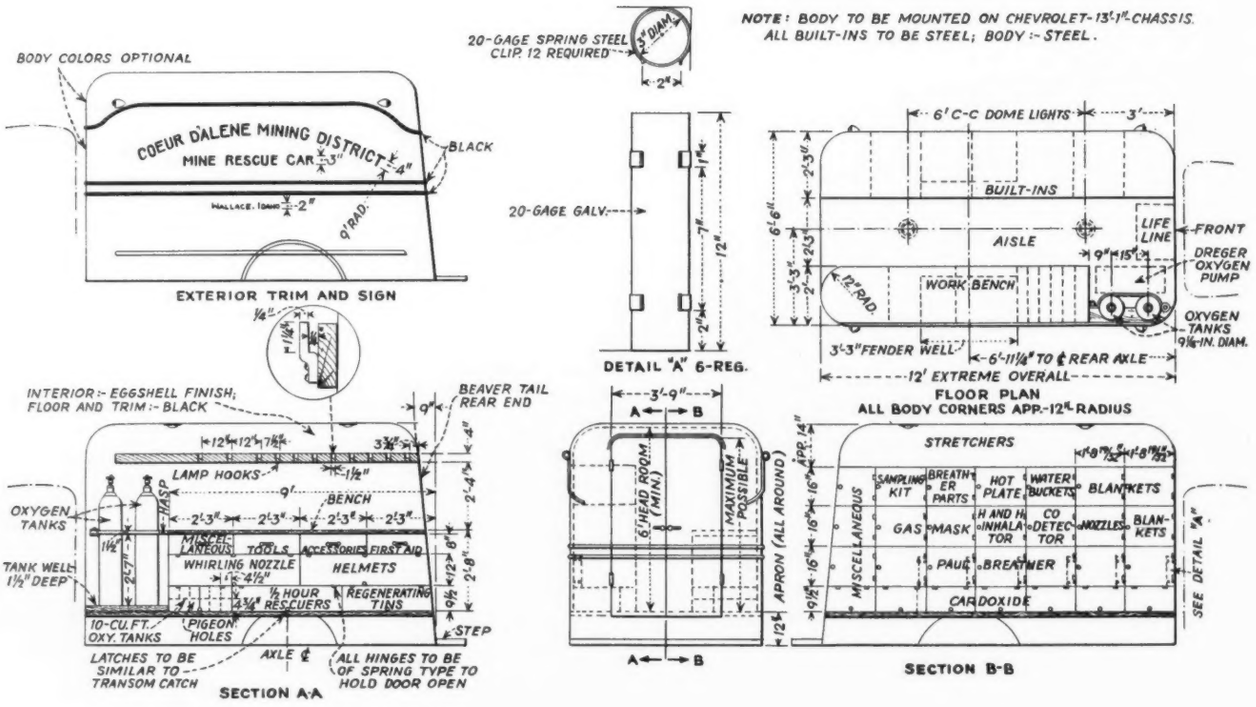
THE FIRST USE of oxygen-breathing apparatus in the Coeur d'Alene mining district was in 1912 at the Bunker Hill & Sullivan mine at Kellogg, Idaho,[1] writes James Wilson, director of the Central Mine Rescue Station, at Wallace, Idaho. That year three sets of German-made Draeger units had been purchased by both the Bunker Hill and the Hecla mining companies. A short course of training was given by a representative of the United States Bureau of Mines in the use of these sets. The units at the Hecla mine were sent to Kellogg when fire broke out underground on Oct. 7, 1912, which was put out about midnight Oct. 9, before the arrival of a Bureau of Mines rescue car sent from Oklahoma.

The first regular Bureau of Mines training car came to the district in 1913 and repeated its visits yearly thereafter until 1923, when, after a number of serious fires had occurred, a central mine rescue station was established with a full-time director in charge. This station was a re-designed Bureau of Mines car which stood on a spur in Wallace. From 1923 up to the present a Bureau of Mines representative has made yearly visits, spending several weeks in the district with the district director. A course of five two-hour classes in first-aid instruction is given annually at this time at the various mines. These are open for any workers who wish to attend, and large numbers do so each year. Anyone completing the course is awarded a Government first-aid certificate. The Bureau of Mines representative likewise assists in training the men in the use of the breathing apparatus, and mine rescue certificates are awarded those completing this course. Training and review classes are held every three months, records of the men thus trained being kept at each mine. A complete list of the district is maintained at the central station.

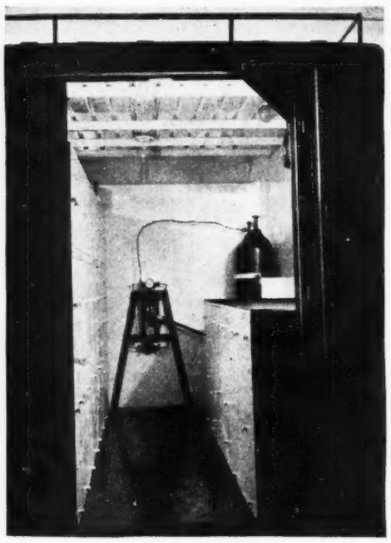
At present the following equipment is in use in the district: Seventy-three Paul two-hour type, self-contained oxygen breathing apparatus; 6 Mine Safety Appliance one-hour type, self-contained oxygen-breathing apparatus; 8 two-hour Burrell all-service gas masks; and 103 half-hour self-rescuers, together with a large supply of repair parts and fire-fighting equipment. All units are kept at the different mine rescue stations on the surface and underground, or at the central station.

In January, 1939, a new mobile rescue unit was placed in service to replace the railroad car mentioned previously. A new central station with workshop and equipment storage facilities and a garage for the truck unit has been provided in the yard of the Federal Mining Company at Wallace, which is centrally situated with relation to the different mines in the district. The new rescue car consists of a 1½-ton, 157-in. wheelbase Chevrolet truck with dual rear wheels, on which is mounted a specially designed

[1] A brief note on mine rescue work in the Coeur d'Alene appeared in the Bunker Hill & Sullivan number of *Engineering and Mining Journal*, August, 1939, on page 79.



aluminum body equipped with built-in fixtures to accommodate sufficient equipment, breathing apparatus, and supplies for a crew for 24 hours. Should a fire be of longer duration, additional units can be obtained either from the central station or from the other mines in the district, as all the equipment is standard. Equipment carried at all times includes 11 two-hour type Paul self-contained oxygen-breathing apparatus; 6 one-hour type Mine Safety Appliance self-contained oxygen-breathing apparatus; 3 two-hour Burrell all-service gas masks; 16 half-hour self-rescuers; 100 cans Cardoxide; 10 10½-cu.ft. and 2 200-cu.ft. oxygen tanks; 1 oxygen hand pump; and repair parts for the units enumerated. Miscellaneous equipment carried includes electric hand lamps; gas detectors; blankets; life lines; stretchers, and first-aid supplies, as well as whirling nozzles and other items.



A view of the truck's interior

With the mobile rescue unit described contact with any mine in the district can be made in about an hour or less from the time it leaves Wallace. This was not the case with the old railroad car, as (1) much time was lost in obtaining a crew and locomotive, and (2) contact closer than several miles could not be made with several mines not having rail service.

The new truck and its equipment represents an investment of several thousand dollars, a sum which unquestionably would be returned at the first fire in that the blaze probably could be brought under control at once with a possible saving of life and property. As the rescue car is available almost at once, fire loss can be held to a minimum. The adoption of the new rescue unit demonstrates how in mine rescue work and fire-fighting equipment in the Coeur D'Alene district is constantly being improved.

Drill Sharpening at Broken Hill

DRILL sharpening at the plant of North Broken Hill, Ltd., in New South Wales, Australia, is described in the Feb. 10, 1940, issue of *Chemical Engineering and Mining Review,* of Melbourne, which is devoted almost wholly to this company's operations. Briefly, the sharpening is done in a new shop of steel construction covered with galvanized iron, 99x50 ft. in plan and floored with concrete, the site being such as to give the main (No. 2) shaft the best possible service with reasonably efficient handling for No. 1 shaft steel. Average output per five-shift week is 6,400 drill steels, 100 Jackbits, and 325 picks, bars, etc. Equipment of the shop is as follows:

(1) Three double-sided oil-fired drill-sharpening furnaces of steel construction, lined with firebrick with renewable top arches. Firing is by means of 2½-in. diameter automatically controlled high-low fuel-oil burners to give a capacity of 500 drills per hour, heating to 1,100 deg. C. Fuel supply is pumped from adjacent underground 1,000-gal. storage tank, and air blast is from 6-in. blower, the blower and fuel pump being mounted together and driven by the same motor. (2) Three Ingersoll-Rand and one Holman drill-sharpening machines. (3) Four double-sided hot millers, with individual electric motor drive. (4) Shank grinder, drilling machine, anvils, straightening block, quenching tanks, etc. (5) Special grinder for Jackbits. (6) Racks for storing steels—newly-cut, damaged, steels to be shanked, and finished. (7) Ten special rubber-tired mobile trucks of steel construction with retaining bars on top, to serve as sorting racks and to provide storage.

Philippine Base Metals Have Importance for Japan

Interest centers on the political and economic potentialities of the iron, chrome, and manganese ore reserves

Ralph Keeler
Manila, P. I.

An aerial view of the property of Philippine Iron Mines, at Larap, Camarines Norte, Luzon. Photo by courtesy of "Philippine Mining Year Book"

THE base-metal industry of the Philippines is becoming of more and more importance—to Japan. This is the only conclusion that can be reached after a survey of it and its possibilities[1].

Two base-metal ores occur in sizable quantities in the Islands: iron and chrome. Relatively small deposits of two others, copper and manganese, have been found. Iron-ore exports account for about 5,000,000 pesos of the total for 1939; copper ore and concentrates valued at 2,700,000 pesos were shipped; and chromite exports were valued at 1,400,000 pesos. The total output for the year represents a substantial gain over that recorded for 1938.

Although the Philippines are highly mineralized in the sense that scattering outcrops of various minerals are found all over the archipelago—asbestos, galena, sphalerite, molybdenite—none of these has been found in commercial quantity as yet. It is unfortunate that during the stock-promotional boom of 1935 and 1936 the importance of the base-metal industry was grossly exaggerated.

From an economic and political point of view the iron, chromite, and manganese ore reserves of the Islands are of great potential importance. The former are concentrated in five deposits: at Larap Peninsula, 100 miles from Manila; on the island of Samar; near Paracale; at Surigao, at the northern end of Mindanao; and at Mati, on the southern Pacific coast of the same island. Three of these deposits are being worked, the ore shipped in 1939 being 991,542 tons; the fourth, at Surigao, is owned by the Government; the fifth goes into production this year.

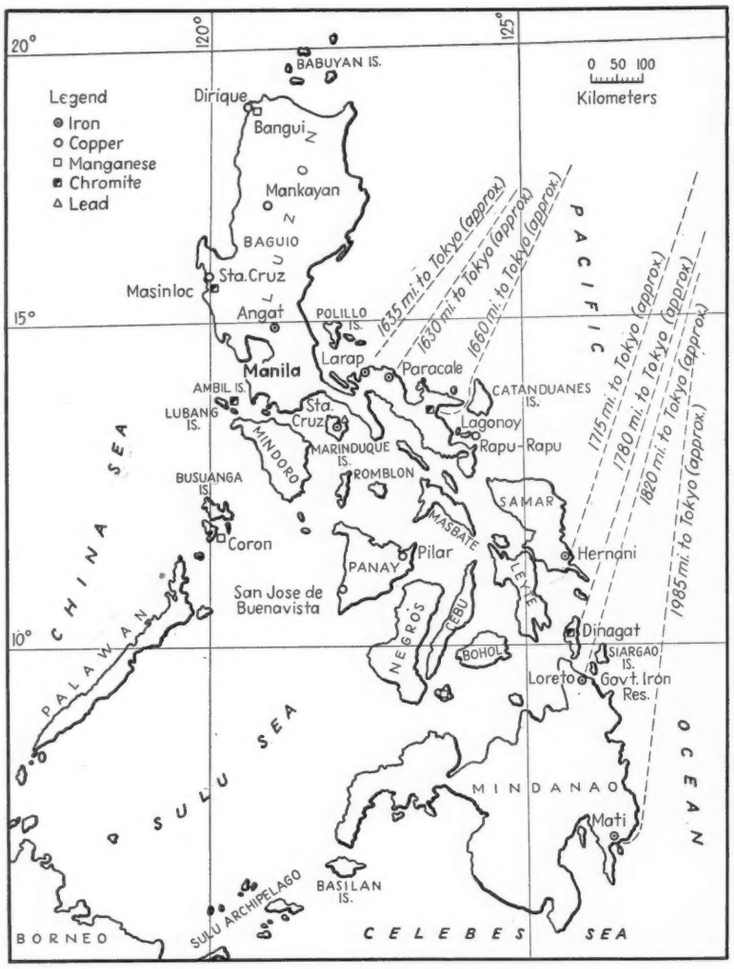
Several small bodies of high-grade chrome (around 50 per cent Cr_2O_3) have been and are being worked in the Islands, but the Masinloc deposit, located some 125 miles north of Manila, is the only one of importance. More than 10,000,000 tons is reported in this deposit, which is being worked by the Benguet Consolidated Mining Company for the owners, Consolidated Mines, Inc. This deposit was described in detail by M. E. Hubbard in the *E.&M.J.* for August, 1937. The essential fact about it, from the dollar-and-cents point of view, is that the chrome is comparatively low in grade, averaging not over 34 per cent Cr_2O_3, and is suitable for refractory, but not for metallurgical, purposes. Much experimental work has been carried on with the object of finding a method for making this ore of metallurgical quality. So far, this work has not met with notable success. Thus, unless some means of treatment is devised, this 10,000,000-ton deposit will be mined at a very slow rate.

The greater part of the ores mined go to Japan; and the future of the base-metal industry depends almost entirely on the ability of the Japanese to buy Philippine ores. No reason exists for expecting that any kind of an iron and steel industry will ever be developed in the Islands. Though there is plenty of iron ore, there is practically no coking coal or other fuel, nor is there sufficient demand for iron and steel products to make the building up of an industry feasible.

Iron.—Largest base-metal operation in the Islands is that of the Philippine Iron Mines, operated by the Atlantic, Gulf, & Pacific Company of Manila (American). This property was described in detail in the *E.&M.J.* for August, 1937 (page 422). Production in 1939 was 701,007 tons, valued at 2,885,012 pesos, compared to 776,409 tons for 1938. Ore reserves are estimated to be between 4,000,000 and 5,000,000 marketable tons, averaging better than 60 per cent Fe. The company has a contract with Iwai & Company, Ltd., of Tokyo. Most of the ore goes to Yawata, near the main works of the company. If shipping space is available, and funds are forthcoming from Japan, the company expects to ship more than 700,000 tons in 1940.

Next largest iron producer is the Samar Mining Company (Spanish),

[1] The cooperation of W. F. Boericke of the Bureau of Mines, Manila, in the preparation of this article is gratefully acknowledged.



Map of the Philippines showing the location of the principal deposits of iron, copper, manganese, chrome, and lead, as well as their distances from Tokyo

operated by Elizalde & Company of Manila. Production in 1939 was 290,535 tons, valued at 1,234,773 pesos. The 1938 output was 118,919 tons, valued at 505,405 pesos. Reserves are estimated to be around 1,500,000 tons of over 60 per cent ore. The entire output goes to Mitsui Bussan Kaisha, of Tokyo. Shipments are made to Kirojata (near Kobe) and Yawata.

Agusan Gold Mines has an iron property in the Paracale district, being operated by the Insular Mining Operators, Inc. (Japanese-Filipino). Shipments started in June, 1939, and for the year amounted to 96,000 tons, valued at 432,000 pesos. Ore reserves are estimated by the president of the company to be around 2,000,000 tons averaging from 60 to 69 per cent Fe. The ore is shipped to Ishahara & Company, of Kobe, and goes to that port.

The Gold Star Mining Company (Filipino) has a deposit estimated to contain several million tons of iron ore on the island of Marinduque. Shipments made in 1939 were 72,554 tons, valued at 314,831 pesos. The company has a contract with the Pacific Mining Company, of Osaka, and ships ore to Yawata. The property consists of four groups, containing 115 claims in all. Ore reserve estimates have varied from one million to ten million tons, the company reports. The Manila office of the firm states that there is between 2,000,000 and 3,000,000 tons blocked out. The grade averages around 63 per cent Fe, with assays going as high as 67 per cent.

Largest deposit in the Islands is that reserved for the Government at Surigao. Some 500,000,000 tons of ore averaging slightly under 50 per cent iron is available close to the coast, and work done by the National Development Company has indicated as much more a little farther inland. Thus 1,000,000,000 tons of ore is under governmental control. Negotiations have been conducted with Japanese interests for the sale of this ore. Though the Japanese are reportedly interested in acquiring this ore, satisfactory arrangements for payment could not be arranged. A survey of the property was complete during 1939, and at present there is no activity at Surigao.

The only new discovery made in the past few years has been at Mati, at the northern end of Pujada Bay on the southern Pacific coast of Mindanao. The property was found by a party working for the Atlantic Gulf & Pacific Company, of Manila, already mentioned. Development was started in June, 1939, and around 100,000 pesos has been spent on the property to date. So far 1,500,000 tons of ore has been proven, running over 60 per cent iron. It is planned to spend 500,000 to 600,000 pesos on a plant, production to start this year.

There is a small iron operation in Bulacan, not far from Manila, where crude pig iron is obtained from a primitive blast furnace. The product is used principally for making farming implements for use in the locality. This is the only operation of its kind in the Philippines, and its output is negligible.

Chromite. — The main source of chromite exports from the Islands is the Masinloc deposit, in Zambales, from which 31,100 tons, valued at 559,200 pesos, was shipped in 1939. This ore all went to Lavino Brothers, of New York. About 3,000 tons a month is scheduled for 1940.

Near the Masinloc deposit is that of the Acoje Mining Company (American-Filipino), at Santa Cruz. About 150,000 tons of high-grade (48 to 51 per cent Cr_2O_3) ore is available. During 1939 18,239 tons, valued at 401,258 pesos, was shipped, all going to Philadelphia for the Union Ore Corporation, of New York. The 1938 production was 14,844 tons, valued at 326,583 pesos. Ore reserves are estimated to be 131,000 tons, running from 50 to 51 per cent Cr_2O_3.

In the same area the Zambales Chromite Company is making small monthly shipments to Baltimore, Md. The ore runs around 48 per cent Cr_2O_3. The 1939 production was 12,920 tons, valued at 298,148 pesos, of which 4,400 tons went to Japan, and the rest to the United States. Ore reserves are given as around 100,000 tons. This company is Filipino-controlled.

On Dinagat Island, just north of Mindanao, the Tagobomar Development Company produces a small amount of chromite: 1,008 tons, valued at 16,820 pesos, in 1938 (1939 figures unavailable). This company is Filipino-controlled. Its ore reserves are believed to be but a few thousand tons.

The Florannie deposit of high-grade (over 48 per cent Cr_2O_3), amounting to around 100,000 tons, has been exhausted in the past three years. All of it was shipped by Benguet Consolidated, the operators, to the Union Carbide Company. Shipments in 1939 were 2,200 tons, valued at 35,187 pesos.

Dinagat Mines, Inc., shipped 5,412 tons of chrome ore, valued at 84,935 pesos, during 1939, from its property on Dinagat Island, off the coast of Surigao. This ore went to Europe until the outbreak of war. In January

the company shipped 2,000 tons to Baltimore, with 3,000 tons scheduled for March for the same place.

Filipinas Mining Corporation shipped 14,000 tons of chrome ore during 1939, the grade running from 45 per cent Cr_2O_3 up. This was all consigned to the Toho Metals Refining Company, of Tokyo. Ore reserves are around 100,000 tons. Orders for regular monthly shipments of 1,000 to 2,000 tons are reported.

A small deposit is reported on Ambil Island, in the Lubang group, just outside Manila Bay.

Copper.—The chief producer of copper is the Lepanto Consolidated Mining Company, which reopened an old Spanish mine in Mankayan, about 150 miles north of Baguio. The flotation plant treats a low-grade (3 to 3.5 per cent Cu) ore and produces a concentrate carrying from 26 to 28 per cent copper.[1] This is shipped to various Japanese concerns, most of it to Mitsui Bussan Kaisha. Ore reserves are estimated at 391,000 tons: 292,200 tons of positive ore averaging 3.7 per cent Cu and 0.06 oz. Au; 98,800 tons of probable ore, averaging 3.3 per cent Cu and 0.5 oz. Au. The company is managed and operated by L. R. Nielson & Company. Both are American. A Mace smelter has been ordered by Lepanto, and is expected to be in operation by the middle of the year.

Hixbar Gold Mining Company has a body of high-grade copper ore on the island of Rapu Rapu, off the Pacific coast of southern Luzon. Its 1939 shipments were 23,200 tons, valued at 889,440 pesos, all going to Japan. Ore reserves are estimated at 33,775 tons of about 9 per cent Cu.

Philippine Copper Mines, Inc.[2] (American-German) has a property in Ilocos Norte, about 30 km. from Dirique. Small shipments of high-grade ore were made during 1938 and 1939, to Japan. Ore reserves are estimated to be 50,000 tons of plus 5 per cent Cu; 2,000 tons of plus 10 per cent Cu; and there is 1,500 tons of 4.7 per cent Cu in the stockpile. Prospects for development of additional ore are considered good.

At the San Remegio mine, in Antique province, there is around 5,000 tons of 5 to 7 per cent Cu in the stockpile. From 1935 to 1938 around 21,000 tons of ore was shipped to Japan. Reserves are indicated to be around 22,000 tons.

The Pilar Copper Company, near Capiz, on the island of Panay, has 250 to 300 tons of high-grade (12.8 per cent Cu) copper ore in a stockpile. Reserves of a few thousand tons of around 10 per cent quality have been indicated by mine development.

Copper bullion and copper matte are shipped to Tacoma smelter from the Philippine Smelting Company at Mambulao from the treatment of concentrate from San Mauricio, United Paracale, North Camarines plants. The amount of copper thus produced, however, is relatively unimportant.

Manganese.—Accurate information[3] as to the extent of manganese ore deposits in the Philippines is not available. Shipments are being made from two areas—Busuanga Island and Siquijor Island. A considerable amount of low-grade ore is known to exist in the Ilocos area. Attempts to bring the grade up to shipping quality by means of washing and sorting have so far not proved successful and at present there is little activity in this region. Approximately 10,000 tons of ore is stockpiled on Busuanga, with prospects for sizable production considered excellent. The Siquijor Island deposits appear to contain in excess of 50,000 tons of fair grade.

Since shipments of ore were first made, a few years ago, considerable difficulty has been experienced because of high moisture content and low quality. It is generally felt, however, that the Philippines will eventually be an important source of manganese to world markets, particularly to the United States and to Japan if present market prices prevail.

The Philippine Nippon Mining Company was the largest producer of manganese in 1939. Its manganese mine is considered one of the best in the Islands. The property of the company is now under the management of the Luzon Stevedoring Company (American) of Manila. About 600 tons of ore a month is being shipped to the United States. The quality is better than 50 per cent Mn.

Production of manganese ore during 1939, as near as can be determined from shipping records, is given in Table I.

A small flotation plant on Marinduque Island operated by Mineral Resources, Inc., during 1938 for the production of lead-zinc concentrate was shut down in 1939 because of the low price of zinc. There is a small amount of ore here which may be mined if the price goes up.

Table I—Production of Manganese Ore in Philippines, 1939

	Tons
Ilocos Norte	1,500
Masbate	2,500
Camarines (Amalgamated Minerals)	3,000
Busuanga (Philippine-Nippon)	6,000
Masbate (Amalgamated Minerals)	6,000
Bohol	2,000
Siquijor	5,000
Busuanga	2,000
Busuanga	5,000
Negros	2,000

Table II—Base Metal Production

(Bureau of Customs Figures)

	1939 Pesos	1938 Pesos
Iron ore	5,106,589	4,080,645
Chrome ore	2,153,590	1,576,845
Copper ore and concentrates	1,617,205	1,283,301
Manganese ore	763,898	999,185
Lead	28,470	11,611
Totals	9,669,752	7,951,587

[1] Mining and milling operations are described in Inf. Cir. No. 3 of the Bureau of Mines, Manila.

[2] Information from Wendell W. Fertig, consulting engineer, Manila.

[3] Details of this branch of the industry were described in the *E.&M.J.*, May, 1938, by R. Keeler (page 29).

Table III—Base Metal Production

	1938 Tons	1938 Value, Pesos	1939 Tons	1939 Value, Pesos
Iron				
Philippines Iron Mines	776,409	3,493,715.80	701,007	2,885,012.01
Samar Mining Company	118,919	505,405.75	290,535	1,234,773.00
Gold Star Mining Company	17,077	72,577.25	72,554	314,813.00
Agusan	.....	.....	96,000	432,000.00
Totals	912,405	4,071,698.80	1,160,096	4,866,598.01
Chromite				
Acoje Mining Company	14,844	326,583.87	18,239	401,258.00
Filipinas Mining Company	.....	.....	8,898	140,646.00
Florannie	13,870	398,373.40	2,200	35,187.00
Consolidated Mines	10,070	49,374.70	31,000	559,200.00
Zambales Chromite	.....	.....	12,920	298,148.69
Tagobomar	1,008	16,820.89	.....	.....
Dinagat	.....	.....	5,412	84,935.00
Totals	39,792	791,152.86	.....	.....
Copper				
Lepanto Consolidated	119,521	990,510.46	137,222	1,861,152.53
Hixbar	2,159	80,465.37	23,200	889,440.47
Philippine Copper	800	8,927.63	.....	.....
Totals	122,480	1,079,903.46	.....	.....
Manganese				
Philippine Nippon	4,130	112,290.00	6,000	161,850.00
Cia. Minera	2,107	42,140.00	1,050	18,000.00
Grawfus Manganese	6,799	112,502.60	.....	.....
Amalgamated Minerals	.....	.....	.....	232,706.74
Philippine Manganese	575	9,200.00	.....	.....
Totals	13,611	276,132.60	.....	.....
Lead-Zinc				
Mineral Resources	27,791	226,778.69	.....	.....

How the Geological Survey Serves Alaska

Its many-sided work began when Congress made its first appropriation in 1895 for developing the Territory's mineral resources

Philip S. Smith
Chief Alaskan Geologist
United States Geological Survey
Washington, D. C.

SPECIFIC RECOGNITION of the Federal Government's responsibility for assisting the development of the mineral resources of Alaska may be considered to date from 1895, when Congress made the first definite appropriation for that purpose to the Geological Survey. The work then started has been continued uninterruptedly ever since, though from time to time it has varied in its scope and in the number and character of the investigations carried on because of fluctuations in the amounts of money available and the changing stress placed on various departments of inquiry. Throughout these years the fundamental purposes to which the funds thus granted were devoted may be tersely summed up in the language of the current appropriation act by which the money is made available as "for continuation of the investigation of the mineral resources of Alaska."

The broad scope of the subject thus entrusted to the Geological Survey may be appreciated when it is realized that its proper fulfillment necessitates thorough search of every part of the Territory to determine what rocks and minerals it contains, so that those susceptible of use and commercial development under existing conditions may become known and that waste of the public's time, effort, and money may be reduced by avoiding those areas that do not appear to hold such promise. In the main the four important questions the Survey is called on to answer are, what kinds of mineral resources exist in the Territory, where do they occur, what are their characteristics, and what amounts of mineral material do they contain.

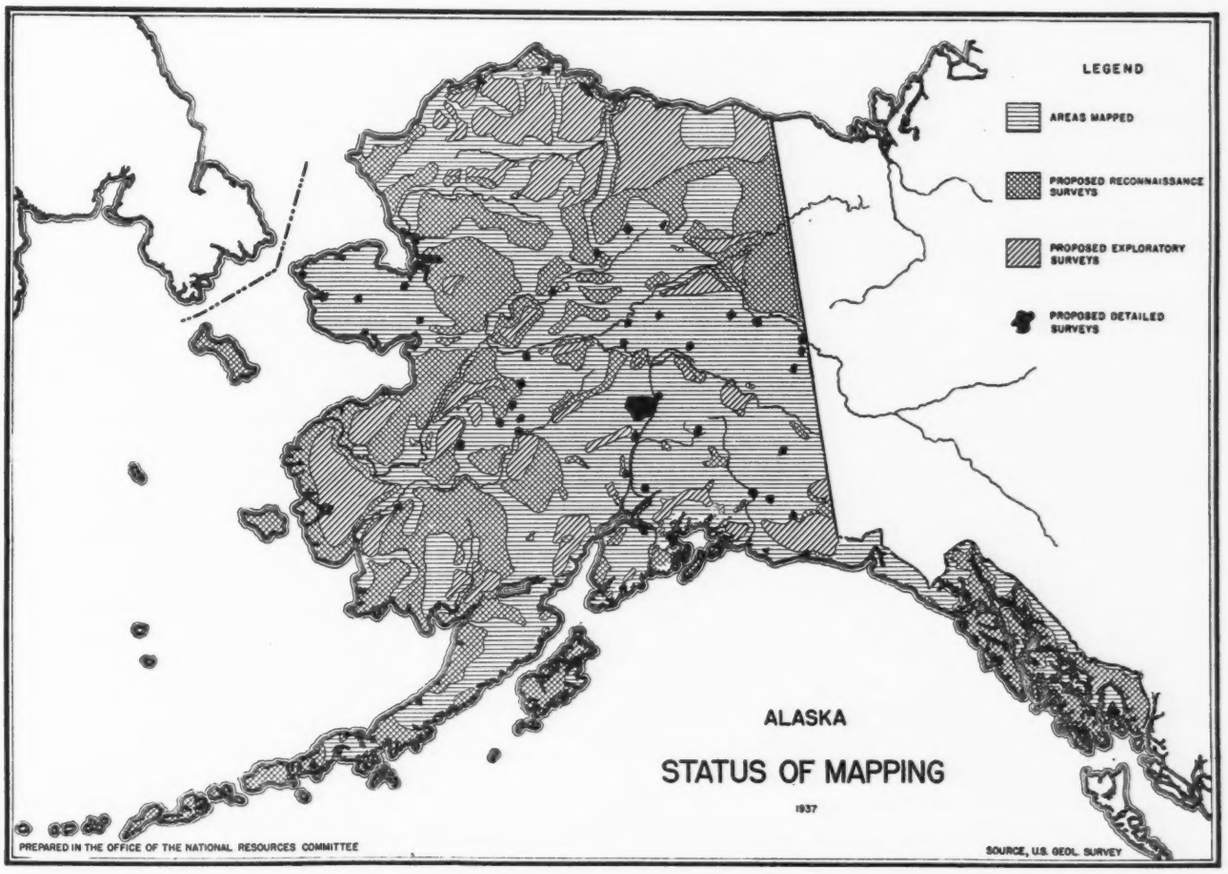
When this work was started, little was accurately known about most of these matters and practically the whole of interior Alaska was an unknown wilderness except to a few pioneers and natives whose knowledge had little general circulation. Much of the early work of the Geological Survey was therefore of an intensely primitive pioneering type—as some of its work is even now. The trails of its parties were often the first marks of white men left on the country they traversed; their boats and canoes in places were the first to travel on some of the remote waterways, and their members were often the first to map and record facts regarding the nature of the country adjacent to their journeys. The mere task of sustaining themselves was often dangerous and soul-trying, even if the strain of continuously carrying on exacting and abstruse technical investigations of the natural phenomena could temporarily be subordinated. This work therefore demanded men not only of thorough professional and scientific training, but also those proficient in living and operating under varied frontier conditions wherein the exercise of knowledge of woodcraft, care and utilization of horses, dogs, and boats, and the performance of arduous physical labor are accepted as integral parts of the routine.

For these reasons, the Alaska work of the Geological Survey differs from nominally comparable work in the United States proper, and to adapt its methods to these differences, a separate unit was set up in the Survey in 1903 to handle all of its Alaskan work. This unit is called the Alaskan Branch, and what proficiency it may now have is in a large measure a legacy of the foresight and training that were integral parts of the work as organized and long participated in by Alfred H. Brooks, who was the first chief of the unit. Others whose professional work in Alaska and elsewhere has left permanent imprint on American science and technology are geologists: W. C. Mendenhall, A. C. Spencer, J. E. Spurr, A. Knopf, G. C. Martin, S. R. Capps, F. E. and C. W. Wright; topographers: R. H. Sargent, D. C. Witherspoon, T. G. Gerdine, J. W. Bagley, W. J. Peters, and D. L. Reaburn; water resources engineers: F. F. Henshaw, G. L. Parker, C. E. Ellsworth, R. W. Davenport, and G. A. Waring, to mention only a few of those who are no longer connected with the Branch.

The technical work of the Alaskan Branch may be described under four more or less distinct heads, though they all form parts of the single main project. These four lines of investigation are topography, geology, statistics of production, and water resources. Each of these will be described briefly in the following paragraphs.

Maps are indispensable in any investigation involving the position of things on the earth. When the Alaska work was started, the absence of adequate maps of practically all of inland Alaska made it essential that the Survey parties prepare maps showing the routes they traveled, their relation to known features, and the location of all features observed in the course of the expedition and their conjectured extension into adjacent areas. As a result surveys are made in the field, from which complete topographic maps can be prepared which show all of the physical features of the country traversed in their correct positions and relation to each other, and the heights of all parts of the terrain, so that the altitudes of all peaks and highlands are determined and the direction and amount of all slopes portrayed.

Three standards of surveying have been adopted: (1) relatively inexpensive exploratory surveys covering large tracts of unexplored country, much of which is not likely to be of general interest in the near future; (2) reconnaissance surveys which will show the principal features of the country; and (3) detailed surveys of those areas such as some of the more productive mining camps where more intensive developments are in progress or are likely to take place soon. The amount of information and the accuracy of its delineation are of course much greater on the detailed maps than on those of the other classes, because for the exploratory class a distance of about eight miles or more in nature is represented by a distance of only an inch on the map, whereas on the reconnaissance map a distance of about an inch would represent four miles in nature and on the detailed



maps about one mile. Stated in other terms, all features occurring in nature within an area of 64 sq.mi. would have to be represented on the Survey's exploratory map within a square inch of paper, whereas on a reconnaissance map the same area would be shown within a space of four square inches, and on a detailed map in a space of 64 square inches.

The following table shows the areas that have been covered by topographic surveys in Alaska up to Jan. 1, 1940:

Exploratory, 84,952 sq.mi.
Reconnaissance, 185,586 sq.mi.
Detail, 4,542 sq.mi.
Total, 275,080 sq.mi.

According to the record, approximately half of the Territory's 586,400 sq.mi. of land has been covered by topographic maps of the Geological Survey on one or another of the standard scales. Ultimately all of the unmapped country will be surveyed and much of the country that has now been surveyed only on exploratory or reconnaissance standards, will need to be surveyed on larger scales as the demands for more precise information become more urgent. In fact, at present less than 1 per cent of Alaska has been surveyed with the degree of precision that is now considered appropriate for even general topographic mapping in the States.

Although of prime importance to the mineral industry, these topographic maps are extensively used and almost indispensable in most of the other activities in the Territory such as aviation, settlement, intercommunication, and land utilization. An index map showing the areas covered by these maps and listing those that are available, as well as furnishing information as to their prices and other details, may be obtained free from the Director of the Geological Survey, at Washington, D. C.

Geologic work of the Alaskan Branch has been directed mainly to the examination of the known occurrences of mineral deposits in the Territory and the application of the facts they disclose to the search for comparable conditions in other areas where valuable deposits have not yet been discovered. In the course of this work thousands of individual prospects have been examined and more than 50 of the principal mining centers studied with some degree of thoroughness, and nearly half of the Territory mapped geologically. The same three distinctions of exploratory, reconnaissance, and detailed, as are made for the Survey's topographic mapping, are also used in referring to the character of its geologic surveys. A summary of the area covered by these different classes of geologic mapping is as follows:

Exploratory, 107,152 sq.mi.
Reconnaissance, 148,597 sq.mi.
Detail, 4,071 sq.mi.
Total, 259,820 sq.mi.

Collection of data in the field is only a small part of the task of the geologists in reaching their conclusions and putting the material in a form that will be useful to the public. With the cooperation of their associates in the Survey, if necessary, thorough chemical tests or microscopic examinations are made of the specimens and samples collected; exhaustive library search is carried on to find descriptions of comparable deposits or features anywhere in the world, that might throw light on those under investigation; identification, and the determination of the age of fossils that may have been found in the rocks of the region are worked out; sketches and maps that clarify significant points are prepared and a complete text describing all pertinent phases of the investigation is written. The resulting complete report, which usually is accompanied by both topographic and geologic maps, after going through the many additional steps incident to its printing or reproduction, is made available to the public at a nominal price. Several hundred such reports on different areas or phases of Alaska geology have already been issued, and reference to some of them as well as to the topographic maps that are for sale, is given on the index that, as noted in the foregoing, can be obtained free from the Director of the Survey.

Statistical studies of the mineral production of the Territory for each

year afford an authoritative record of past and current conditions and indicate trends that are significant in suggesting the manner along which the future development of the industry is likely to proceed. To obtain the information recorded by these studies, the Geological Survey utilizes all of the usual sources of information such as receipts at banks, mints, assay offices, customs declarations, and express and other shipments. In addition, it canvasses each producer by sending out each year hundreds of inquiry forms—one to each person or company known to be engaged in mining in Alaska. Information from all these sources is compiled and coordinated so as to bring all to a single standard that is consistent within itself and with the series of earlier records of mineral production. The principal mineral products entering into the yearly output from Alaska mines have been gold, copper, silver, coal, platinum metals, marble, lead, and tin, but many other mineral products such as petroleum, lime rock, antimony, gypsum, tungsten, and quicksilver contributed lesser amounts to bring the total value of the output of minerals from the Territory at the close of 1939 to more than $800,000,000.

To determine the supplies of water available, the Geological Survey in 1906 began the measurement of some of the Alaska streams and other sources that might be utilized by some of the mining camps in interior Alaska. This work broadened out and later included the examination of possible sites for the generation of water power. For some fifteen years these general water measurements and studies were made of many streams in Seward Peninsula, the Yukon-Tanana region, south-central Alaska, and southeastern Alaska, and examinations were made of some of the numerous mineral springs. Much important general information was also obtained and made available to the public. However, finally the pressing need of all the funds appropriated for the Alaska work, for other classes of mineral examinations, necessitated suspension of the water-resources studies in 1922, and it has not yet proved practicable to resume them. This suspension would have been felt as an even more serious handicap by those concerned with the development of the Territory's water resources had it not been possible for the Federal Power Commission and the Forest Service to keep alive certain of the investigations of power sites in southeastern Alaska, and to maintain some of the records unbroken to the present time. Seven separate reports regarding Alaska water resources have been issued by the Geological Survey as Water Supply Papers, and a number of shorter articles in other forms have been published to set forth the results of the Branch's examinations in this field.

The Alaskan Branch is also frequently called on to undertake special studies or to act in an advisory capacity to other Federal or Territorial agencies. Thus it serves more or less continuously as consultant to the Alaska Railroad on mineral subjects, especially those concerned with enterprises that may contribute tonnage. The Branch has made extensive surveys at the request of the Navy Department in the great petroleum reserve that was set aside in northern Alaska, for its use. Studies of the so called "strategic minerals" which are of special interest to the War Department in its program for national defense are now receiving special attention. When needed the Branch furnishes technical information for use of the General Land Office in its administration of the public domain under the various laws affecting mineral lands. For a while, in cooperation with the University of Alaska, the Branch maintained a chemical laboratory near Fairbanks to assist prospectors and others by making tests of specimens of rocks and minerals they submitted.

Alaskan Branch works with other units of Federal Government

Close cooperation is at all times maintained and service rendered as required to the Bureau of Mines, the National Park Service, the Forest Service, the Alaska Road Commission, and a number of other official Federal and Territorial units. Preparation of special reports and memoranda, appearance before or service on boards, committees, or other organizations either of official or private character, are common services rendered by the personnel of the Alaskan Branch in placing their store of information at the disposal of those whom it may aid in arriving at informed judgments. The long and intimate familiarity with general Alaska affairs gained by its personnel in the course of their field work has even enabled the Branch to serve at times as a clearing house for many of the curious and indefinite inqueries regarding Alaska that are received in Washington, but which cannot be answered by other units, this service, of course, being in addition to answering the hundreds of letters received each year concerning subjects that do pertain to its special fields.

In the preceding paragraphs the work of the Alaskan Branch has been described as that of the more or less independent unit which in many respects it is, but in addition the Branch enjoys the great advantage of being also part of a large organization—the Geological Survey—whose more extensive facilities are freely at its service. Thus the several hundred technical specialists in geology, topography, and water resources in the States investigations are always exceedingly helpful in assisting and advising their Alaskan associates. The benefits of the specialized knowledge of the Survey's editors and illustrators are shown by the skillful improvements they make on every Alaska manuscript that passes through their hands. The fully equipped chemical and petrographic laboratories of the main organization can be counted on for taking up problems requiring special attention. The unrivaled geological library of the Survey or the other great libraries of Washington are freely open for consultation and use. The Survey's great engraving and printing plant, with its elaborate facilities for photography and all phases of map reproduction, not only attends to all details of publishing the Alaska maps but is also of assistance in countless ways at all stages during the preparation of the original drawings. All the technical instruments used by the Alaska force are kept in prime condition and some of the special equipment is constructed from original designs by the skilled mechanics and technicians of the Survey's extensive instrument shop. Even the task of attending to many of the business details of the Branch are lightened by the Survey's staff of skilled bookkeepers and others concerned with proper accounting procedure, and by the officers and clerks whose duty it is to keep constantly current on matters of departmental and bureau procedure and practice, and legal requirements.

That the public does value and is guided by the Survey's Alaska work can be demonstrated by the existing records which show that many of the present mining developments have been based on the finding of the Survey parties. In part, the value of the work is shown by the fact that hardly any enterprise connected with Alaskan affairs is undertaken without recourse to the Survey's maps, which are the source of practically all authoritative information regarding the natural features of interior Alaska. In part, its value is demonstrated by the fact that those who know the quality of the work most intimately are its most ardent advocates and supporters. By frontiersmen the members of the Survey's parties are looked up to as worthy members of the brotherhood of the trail; by scientists and other professional workers they are recognized as specialists of high attainment; and by the general Alaska public they are welcomed and respected as earnest, experienced experts who are striving to utilize to the utmost their talents for the common good, so that our great northern empire may receive the recognition that is its due.

Mining Gold in the Hedjaz

After the lapse of centuries the metal is again being worked in the Mahad Dahab field, in Saudi Arabia

S. O. Hatton
The Mining Club,
London, England

A view of the mine camp. 1, Radio station. 2, Headframe over shaft. 3, Staff mess. 4, Staff house. 5, Ancient tailings. 6, Main office. 7, Arab police guard. 8, Doctor. 9, Assay office. 10, Mine store

MODERN metallurgical methods have been the sole means of bringing into production the ancient gold mines in the Mahad Dahab gold field, Hedjaz, Saudi Arabia, which have been abandoned for more than a thousand years. From the start of prospecting the British-American syndicate was handicapped with difficulties. A kindly government official suggested, however, that the company might try a place with an historical name, "Mahad Dahab," meaning "cradle of gold," where the ancients were reported to have won large quantities of the metal, of which he said, "None remained that human eyes could see." The company tried its luck in the areas indicated, and so gold mining in the Hedjaz was reborn.

The mine at Mahad Dahab is about 3,200 ft. above the sea and is connected to the port of Jeddah by a clever bit of road engineering, 250 miles in length. The only excitement the traveler gets is at the Wadi Hamar rest house, where he meets an old character, "George" an Egyptian Arab who remembers events in succession from the days of Omdurman to the finding of the mine. Geographically, the mine is on the Tropic of Cancer, somewhere along the camel trail between Mecca and Medina, and about 30 miles from the famous water holes of Soufina, an oasis, where the company has its tube-well from which the mill draws its water through a specially constructed pipe line.

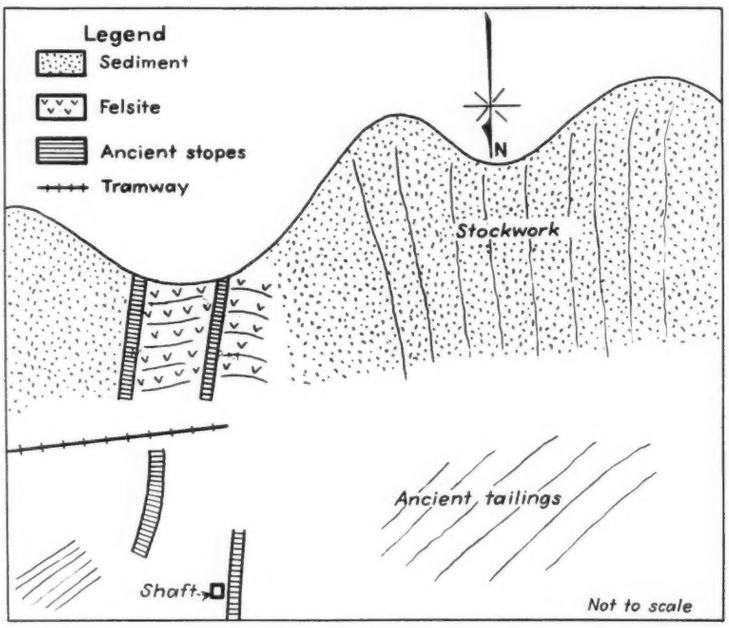
Designed to treat just over 300 tons of ore per day, the mill, at the mine, was planned in Toronto. As the ore is complex and consists of an intimate mixture of copper pyrites, galena, sphalerite, gold and silver, and carbonates and sulphates, most of which are cyanicides, the cyanide plant has been equipped with a flotation unit by Denver, to remove by differential flotation the copper, lead, and zinc, and to make a concentrate of gold, silver, and lead for shipping to the United States. The greatest problem, so far, has resulted from the heavily mineralized water from Soufina, the effect of which is a natural flotation of the minerals without the addition of any reagents. This matter is now receiving attention.

From my point of view, the most interesting feature of the mine is its surroundings, and their geological aspects. The geological work done at the mine is small. Several theories about the structure of the Arabian peninsula have been propounded from time to time. Local geographical conditions have, however, been so forbidding that it is not surprising that our geological knowledge of this part of the world is almost as meager as our knowledge of the "empty quarter" within the heart of the great Arabian table land. It is by studying the geological features of the land immediately west and east of the Red Sea, that one can form some idea of what has occurred in the Arabian highlands, including the Hedjaz, through geological time.

The Mahad Dahab area is in the Arabian-Nubian massif, which Suess had aptly called the "Arabian shield" or "table." The main core of this "table" would appear to be the Pre-Cambrian series of Sudan-Egypt. Sudan-Egyptian granites have been identified in the Akaba region of Sinai. These Archean rocks give evidence of a mantle or covering of Paleozoic sands and sediments, which have been severely denuded over large areas of the table land. On the eastern border of the "table," there is a continuous belt of typical Jura folding. There is no doubt from the "remnants" in the nature of hills, and the highly mineralized local water supplies, that sedimentary formations did exist. One observes in the Mahad Dahab areas granite outcrops and hills, as well as the "remnant" heights and spurs of sedimentary formations. Frequently these have been covered by nearly horizontal sills of lava of Tertiary age, which are still *in situ*, though a great denudation has taken place, scattering the bombs and fragments all over the desert country, now known as the "lava country."

The large saddle-back hill at the mine, which is some 600 ft. above the rest of the 3,000 ft. high plateau country, is of a well-defined sedimentary nature. Quartz veins and quartz stringers run through it in an approximate north-south direction, forming a type of stockwork. These veins are, however, practically barren of gold, and assay up to 0.2 dwt. per ton. Not so the main spur that shoots off this hill in an approximate northeast direction. The ore from the spur, in which are situated the old stopes of the ancient miners, has a gold content of about 5.8 dwt. In places in very short, quartz-filled fissures, the values run to 2 oz. per ton, but these are too insignificant to be of economic importance. The open cut in the spur is the mainstay of the mill, apart from the enormous tonnages available in the ancient mine tailings, of an assay value running 14 dwt. to the ton. These tailings mixed with selected quarry ore make up a rich grade for the mill. With the present-day price of gold at 168s. per fine ounce, the mine is a handsome investment, for the next year or two, which is the estimated life of the tailings deposit.

In my opinion, the mine is situated on a well-defined shear-belt or zone, running northeast to southwest (approximately with a corresponding northwest dip). The oreshoots pitch where there is a deflection or break in the strata or orebody. Open-cut ore is in nature a felsite. The shear



Sketch showing the ancient workings and the geological relationship

zone may be the result of tangential slip, or drag movements, preceding the Red Sea rifting.

I am also of opinion that there is an older granite of Pre-Cambian age, and a younger granite of the Paleozoic era. The intrusions of the younger granites, and a diorite facies, together with acid and basic lavas, have undoubtedly been responsible for the gold. Among the Archean rocks I would include a basement complex and a gneiss-schist complex. Igneous activity must have been fairly pronounced, with deep-seated intrusions of acid and basic magma, and of extrusion of surface flows yielding minerals of economic importance. Some such activity may also have occurred in Paleozoic times as well.

In the contact zones or in the schist folds, gold always occurs much richer than in the felsite of the open-cut spur ore, where it varies considerably, as I have already remarked. Some gouge occurs in the hanging wall and the footwall, and in the shear and tension fractures due to west-east compression. The old stopes in the orebody have nearly parallel sides with a hanging-wall contact with the metamorphosed sedimentaries, and a footwall contact with the felsite orebody. The veinlets in the spur orebody show siliceous gold-bearing solutions diffusing through the stage of calcite mineralization, which undoubtedly neutralized the acid solutions. Where the quartz stringers become more massive, or rather wider, the gold content is low or entirely disappears.

The primary minerals are pink to purplish-pink magnesium and calcium carbonates and some manganese carbonate, with high pyrites, and some marcasite. There is also some ankerite. Gypsum and the sulphates, with anhydrite, are in the nature of secondary mineralization.

The high-grade shoots represent siliceous gold-bearing solutions; the low-grade quartz in the felsite orebody probably indicates the close of dynamic activity. Galena, chalcopyrite, pyrrhotite, bornite, and sphalerite are associated with mineralization. Much pyrites and some pyrite are the primary constitutents of the intrusives and the mineralizing solutions. There is little secondary enrichment due to the carbonates and the basic nature of the highly mineralized ground and local waters. Gypsum, epsomite, and anhydrite are abundant.

This explains a feature in the areas, that where massive quartz or wider veinlets of quartz have been found, they are generally barren, but where the quartz appears in very thin laminae in the foliated or wavy schists, it is generally rich in gold and high in mineralization.

The local sedimentaries consist of carbonated shales and sandstones, which, through dynamic metamorphism along a roughly north-east axis of folding, have formed crystalline limestones of a pinkish-red or light purple color. The source rocks, as already mentioned, have been the granodiorites, and the andesites as intrusions, and extrusions of basaltic lavas.

Gold has been found in the gray andesites with greenstone schists. One remarkable specimen which I assayed seemed to consist originally of water-laid gray andesitic tuffs, metamorphosed to a type of quartz-sericite tuffaceous schist, which had weathered and been oxidized to a soft material, very "saprolitic" in nature. Actually it looked like the old-fashioned "bath brick" used for cleaning cutlery, and it assayed 4 oz. per ton. The values in the ancient tailings varied from 10 dwt. per ton to 4 oz. per ton as in the specimen mentioned in the foregoing. Other specimens of rich ore were a quartz-porphyry showing galena, sphalerite, pyrites, and what to me looked like a gold veneer over the pyrites, a form of pyritic gold which I had observed with a hand-specimen lens on some of the quartz reefs of the Lupa gold field in Tanganyika Territory, East Africa.

It is worthy of mention that, in common with others, I have not seen a single specimen of visible gold, even through the hand lens, in the Mahad Dahab gold field. The gold in that field is so finely divided that it is popularly called semi-colloidal, and a study of its form would require an ultra-microscope. After fine grinding to between plus 300, minus 200 mesh, (Tyler) and working a sample on a vanning plaque for a few hours, I find that the precious metal begins to appear as a gold paint, layer covering layer, until a permanent gold lacquering is observed on the plaque, where the gold may be 7 microns in diameter. Some charcoal used by the ancients in their gold-smelting operations was discovered on the site and assayed 8 dwt. per ton.

Hundreds of ancient grindstones and a few fluxing pots and hearths have been discovered, but not a particle of free gold. One wonders whether Mahad Dahab was indeed one of the sources from which King Solomon derived his treasure.

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Copper at Mankayan, P. I.

MINING and milling methods and costs at the property of Lepanto Consolidated Mining Company, at Mankayan, 63 miles north of Baguio, Luzon, in the Philippines, are described in the Commonwealth Bureau of Mines Information Circular No. 3 by W. F. Boericke, N. N. Lim, and F. E. Johnson. This is the principal copper producer of the Islands, it being mentioned in this rôle by Ralph Keeler elsewhere in this issue (page 53). According to the aforesaid information circular, the history of the property dates back hundreds of years.

In 1833, under the Spanish regime, explorers called attention of the authorities to the presence of the metal and five years later an inspection was ordered. A military expedition followed in 1850, and in 1865 an agreement was made with the native chiefs for a concession and the first company was formed.

NEW BOOKS

EQUILIBRES CHIMIQUES ET MÉTTALLURGIE. *By Maurice Rey. Bibliothèque Scientifique Belge, Liège, Belgium. Pp. 259. Bound in paper.*

THIS IS NO. 38 in a series of scientific publications issued under the guidance of a committee from the faculty of the University of Liège. The volume is timely because of the increasing interest in thermodynamics among metallurgists, and the author has made a brief but exceptionally clear presentation of the subject. The book is appropriately dedicated to Henry Le Chatelier, whose general method of attack is followed. The first section of the volume is devoted to a general explanation of the laws of chemical thermodynamics, giving numerous equations, curves, and tables to clarify the discussion.

In the second section the laws are applied to the reduction of the more important metallic oxides. In the appendix are tables giving useful thermochemical data.

The French text is so concisely prepared that it is easily understood even by one who does not have a thorough knowledge of the language.

Those familiar with thermodynamics will enjoy reading this book because the skillful presentation will clarify their thinking. Those whose knowledge of thermodynamics is slight will find it valuable for increasing this knowledge with little effort.

CARLE R. HAYWARD

TERRESTRIAL MAGNETISM AND ELECTRICITY. *Edited by J. A. Fleming, with fourteen contributors. Vol. 8 in the Physics of the Earth Series of the National Research Council. Published by McGraw-Hill Book Company, New York City, 1939. Price $8.*

THE SCOPE OF THIS SUBJECT is conveyed by the monumental volume being reviewed, which consists of nearly 800 pages, yet still cannot be considered a textbook. It is designed more "to give to the reader, presumably a scientist but not a specialist in the subject, an idea of its present status, together with a forward looking summary of its outstanding problems." This book could serve as a guide to a scientist desiring to explore more deeply the ramifications of the subjects discussed, as the authors have thoughtfully provided a bibliography and reference list of over 1,500 items.

Certain portions of the subject matter dealt with in the text will be of interest to scientists in different fields. The radio engineer will find discussions of the radio exploration of the earth's outer atmosphere. The meteorologist can turn to the book for a discussion of clouds and their electrical effects. Students of the upper atmosphere and of the aurora polaris will find two chapters of interest to them. Some chapters on terrestrial magnetism and electricity bring the subject down to earth, as it were.

To those interested in prospecting work, the first three chapters will be of particular value. J. A. Fleming studies the magnetic field of the earth and discusses the variations by which it is perturbed. Magnetic instruments, referring now to types used in magnetic observatories, are dealt with in a chapter by H. F. Johnston, J. A. Fleming, and H. E. McComb. This brings the discussion down to magnetic prospecting, with which C. A. Heiland deals in a chapter of nearly 40 pages.

The inclusion of such a chapter in a book of this type is most gratifying, since it serves to tie in the fields of geophysical exploration to the broader subject of earth physics, particularly in the realm of magnetics.

S. F. KELLY

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PUBLICATIONS

RECEIVED

Electron Basis of Diastrophism. By Halbert P. Gillette. Reprinted from *Pan American Geologist,* February, 1940. Pp. 11 to 20 inclusive.

Nature of the Ore-Forming Fluid. A paper by L. C. Graton, issued under the auspices of the Committee on Experimental Geology and Geophysical Research at Harvard University. Published as a supplement (of 162 pages) to the March-April 1940 issue of *"Economic Geology."* Economic Geology Publishing Company, Prince and Lemon Sts., Lancaster, Pa. Price 70¢.

"Detection and Control of Silicosis and Other Occupational Diseases—What New York State Has Done and the Job Ahead." A progress report to the Legislature by Frieda S. Miller, Industrial Commissioner, New York State Bldg., New York City. March, 1940. Pp. 21, plus a 10-pp. Appendix. (This report is notable for its partisan, alarmist tone, particularly in its pages beginning with page 14, entitled "Poison—Beware"! These start with an anecdote of the Mad Hatter of "Alice in Wonderland." Quoting from the report: "The Hare went mad, the story says, after listening to the Hatter sing. But what caused the latter's affliction is not revealed. It was probably chronic mercury poisoning." Thereupon follows an account of an instance of mercury poisoning, "affecting 175 fur felt hatmakers" in a plant in a small Hudson River community.)

Mining Industry of Idaho, 1939. Forty-first annual report of State Inspector of Mines (Arthur Campbell). This, in the main, is a very useful, descriptive handbook of the mines of Idaho. In addition, numerous articles and other material (including photographs) of interest to those engaged in mining in the State are included. Pp. 341, in contrast with 275 pp. in the 1938 Report. No charge.

Engineering Foundation. Annual Report, 1938-1939. Issued at Engineering Societies Building, 29 W. 39th St., New York. Pp. 47.

German-English Glossary for Civil Engineering. By Alphonse A. Brielmaier. Bulletin of University of Illinois, Urbana, Ill. Pp. 37. Price 45¢.

Nepheline Syenite in Ceramic Wares. By C. J. Koenig. Bulletin 103, Engineering Experiment Station, Ohio State University, Columbus, Ohio. Pp. 74. Price 40¢.

Rock Drilling. By C. E. Nighman and O. E. Kiessling. One of the "Mineral Technology and Output Per Man Studies." Works Progress Administration, National Research Project, in cooperation with U. S. Bureau of Mines (Report No. E-11). Pp. 155.

Industrial Research and Changing Technology. By George Perazich and Philip M. Field. W.P.A. National Research Project, Report No. M-4, Philadelphia, Pa. A study of the influence of scientific research on industrial production and employment. Pp. 81.

Mellon Institute Publications. A List of Books, Bulletins, Journal Contributions, and Patents by Members of Mellon Institute, 1911–1938. Bibliographic Bulletin No. 4. Pittsburgh, Pa. Pp. 242.

A Study of Methods for Producing Chromate Salts From Domestic Ores. By H. A. Doerner and others. Mining Experiment Station and State Electrometallurgical Laboratories, Pullman, Wash., in cooperation with U. S. Bureau of Mines. Bulletin V. Pp. 51. Price 35¢.

Geology of the Draper Mountain Area, Virginia. By Byron N. Cooper. Bulletin 55, Virginia Geological Survey, University, Vt. Pp. 98.

U. S. Bureau of Mines, Washington, D. C., has recently issued: Information Circular 7096, "Open-Pit Mining and Milling Methods and Costs at the Yellow Aster Mine, Randsburg, Calif.," by A. W. Frolli, pp. 46. Also I. C. 7098, "Cooling Mine Air During Summer Months to Prevent Roof Falls," by C. A. Herbert, pp. 14. Also I. C. 7100, "Accident Experience at Pebble-Phosphate Operations in Florida, 1930-38," by F. E. Cash and G. W. Colbert, pp. 13. Also I. C. 7102, "The Cement Industry of Latin America," by Oliver Bowles and R. B. Miller, pp. 38. Also I. C. 7106, "Non-metallic Mineral Industries in 1939," by Paul M. Tyler and Oliver Bowles, pp. 27. Also Report of Investigations 3495, "The Eykometer—A New Device for Measurement of the Yield Point of Clay Suspensions and Oil-Well Drilling Muds," by A. George Stern, pp. 20. No charge for any of the foregoing.

U. S. Geological Survey has issued the following (obtainable from Superintendent of Documents, Washington, D. C. at the price given): Bulletin 910-B. "Platinum Deposits of the Goodnews Bay District, Alaska," by J. B. Mertie, Jr. Pp. 30. Price 15¢.

Dominion Bureau of Statistics, Ottawa, Canada, has issued: "Preliminary Report on the Mineral Production of Canada during 1939." Pp. 44. Price 25¢.

Ontario Department of Mines, Toronto, Ont., has issued: Bulletin 126, "Preliminary Report on the Mineral Production of Ontario in 1939," prepared by Maurice Tremblay, pp. 25. No charge.

International Tin Research and Development Council. Fourth general report, 1939. Publication No. 95. Issued by the Council, at Fraser Road, Greenford, Middlesex, England. Pp. 30.

Tectonic Features of Eastern Anatolia (In Turkish and German): By P. Arni. Series B, No. 4, Institute of Mine Prospecting and Research, Ankara, Turkey. Pp. 90, plus folded maps in colors and tables.

Geology of the Yilgarn Goldfield, South of the Great Eastern Railway (an area of 5,500 sq.mi.). By H. A. Ellis. Bulletin 97, Geological Survey of Western Australia, Perth. Pp. 192, plus 7 folded maps in colors.

Geology and Mineral Resources of the Neighborhood of Raub, Pahang, Federated Malay States, With an Account of the Geology of the Raub Australian Gold Mine. By J. A. Richardson. Pp. 166, plus a geological map, in colors, of the Raub Sheet, by E. S. Willbourn, Director, and J. A. Richardson. Issued by Geological Survey, Batu Gajah, F. M. S. Price $3, Straits.

The Mining Industry in Peru, 1938 (in Spanish). By Jorge Hohagen. Bulletin 124 of the Cuerpo de Ingenieros de Minas del Peru (Bureau of Mines). A statistical report. Published at Lima. Pp. 351.

Brazil's National Department of Mineral Production, Division of Development of Mineral Production, Rio de Janeiro, has issued the following, in Portuguese: Bulletin 38, "Ouro no Centro de Minas Geraes," by Luciano Jacques de Moraes and Octavio Barbosa, pp. 186, plus numerous folded maps and photographs. Also Bulletin 38, "Piritas de Rio Claro, State of Rio de Janeiro," by Henrique Capper Alves de Souza, pp. 30. Also Bulletin 33, "Diatomito do Noroeste," by Henrique Capper Alves de Souza and Silvio Froes Abreu, pp. 56, plus map.

Summary of the

MARKETS

THE heavy buying movement in major non-ferrous metals that occurred in February was followed by pronounced inactivity throughout March and finally resulted in some unsettlement in prices of copper, lead, and tin. Zinc prices remained unchanged. Aluminum was lowered 1c. per pound on March 25. Despite the weakness in prices, the *E. & M. J.* index advanced slightly to 77.94 for March, owing to the fact that the downward tendency did not occur until late in the month. Inability to judge European developments prompted most buyers to curtail their purchases.

Sales of copper for domestic consumption totaled 19,817 tons during March, which compares with 147,112 tons booked during February. Custom smelters and some of the small producers sold copper at 11.25c., Valley, after March 18, but the large mine operators continued to hold out for 11.50c., Valley. The February statistics showed a gain in stocks of refined copper of 9,950 tons, which development exerted little influence on the price structure. Export business suffered because of the self-imposed "moral embargo" on sales to Russia and light purchases by Japan. Ending of the Russo-Finnish war also restricted export sales. The export and domestic quotations for copper were not far apart as the month ended.

Lead was reduced 20 points during the month without attracting much new business. Unseasonable weather has retarded consumption of lead, the trade believes.

Producers of zinc believe that consumers are not well covered and expect buying to revive soon. There was no selling pressure.

Effective March 25, buyers of tin from British Empire sources can only obtain such metal by using "official" pounds.

Silver received increased attention because of a move in Washington to halt the further acquisition of foreign metal by the Government. Whether Congress will act on the proposition remains in doubt.

UNITED STATES MARKET

	Electrolytic Copper		Straits Tin	Lead		Zinc
1940	Domestic	Export	New York	New York	St. Louis	St. Louis
Mar.	(*a*) Refinery	(*b*) Refinery				
1	11.275	11.525	47.500	5.25	5.10	5.75
2	11.275	11.525	47.375	5.25	5.10	5.75
4	11.275	11.550	47.250	5.25	5.10	5.75
5	11.275	11.550	47.500	5.25	5.10	5 75
6	11.275	11.575	47.625	5.25	5.10	5.75
7	11.275	11.575	47.875	5.25	5.10	5.75
8	11.275	11.625	47.750	5.25	5.10	5.75
9	11.275	11.625	49.000	5.25	5.10	5 75
11	11.275	11.600	49.000	5.25	5.10	5.75
12	11.275	11.550	48.750	5.25	5.10	5.75
13	11.275	11.550	48.125	5.25	5.10	5.75
14	11.275	11.500	47.375	5.25	5.10	5.75
15	11.275	11.500	47.125	5.25	5.10	5.75
16	11.275	11.450	47.000	5.25	5.10	5.75
18	11.025	11.450	46.500	5.25	5.10	5.75
19	11.025	11.425	46.500	5.15	5.00	5.75
20	11.025	11.400	46.625	5.15	5.00	5.75
21	11.025	11.325	46.750	5.15	5.00	5.75
22	11.025	11.200	46.750	5.15	5.00	5.75
23	11.025	11.200	46.750	5.15	5.00	5.75
25	11.025	11.200	46.625	5.15	5.00	5.75
26	11.025	11.175	46.000	5.15	5.00	5.75
27	11.025	11.150	45.625	5.05	4.90	5.75
28	11.025	11.125	45.750	5.05	4.90	5.75
29	11.025	11.100	45.625	5.05	4.90	5.75
30	11.025	11.125	45.300	5.05	4.90	5.75
			AVERAGES FOR MONTH			
Mar	11.160	11.407	47.079	5.192	5.042	5.750
Mar.			**AVERAGES FOR WEEK**			
6	11.275	11.550	47.500	5.250	5.100	5.750
13	11.275	11.588	48.417	5.250	5.100	5.750
20	11.150	11.454	46.854	5.217	5.067	5.750
27	11.025	11.208	46.417	5.133	4.983	5.750
Mar.			**CALENDAR WEEK AVERAGES**			
2	11.275	11.613	47.646	5.167	5.017	5.713
9	11.275	11.583	47.833	5.250	5.100	5.750
16	11.275	11.525	47 896	5.250	5.100	5.750
23	11.025	11.333	46.646	5.167	5 017	5.750
30	11.025	11.146	45.821	5.083	4.933	5.750

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(*a*) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(*b*) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the European War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. To arrive at the f.o.b. refinery quotation deduct .05 from the f.a.s. basis for lighterage.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars: cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c per pound over the current market for Prime Western but not less than 1c over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(*c*) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c per troy ounce. Handy & Harman's quotation on newly-mined domestic silver, 999 fine was 70⅝c throughout March.

(*d*) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125.

SILVER, GOLD AND STERLING EXCHANGE

	Sterling Exchange		Silver		Gold	
1940		"90-day	(*c*)			(*d*) United
Mar	"Checks"	demand"	New York	London	London	States
1	3.93250	3.88500	34.750	20.1875	168s	$35.00
2	3.92000	3.88500	(*e*)	(*e*)	(*e*)	35.00
4	3.90500	3.86625	34.750	21.2500	168s	35.00
5	3.88000	3.84000	34.750	20.9375	168s	35.00
6	3.89500	3.85750	34.750	21.0625	168s	35.00
7	3.91500	3.87750	34.750	21.1250	168s	35.00
8	3.91500	3.88500	34.750	21.3125	168s	35.00
9	3.87000	3.83250	(*e*)	(*e*)	(*e*)	35.00
11	3.86500	3.82875	34.750	21.0625	168s	35.00
12	3.81000	3.77500	34.750	20.8125	168s	35.00
13	3.71500	3.68000	34.750	20.6250	168s	35.00
14	3.73000	3.69500	34.750	20.6875	168s	35.00
15	3.69250	3.66250	34.750	20.9375	168s	35.00
16	3.72000	3.69000	(*e*)	(*e*)	(*e*)	35.00
18	3.74500	3.71500	34.750	20.8125	168s	35.00
19	3.75000	3.72000	34.750	20.8125	168s	35.00
20	3.72750	3.69750	34.750	21.0000	168s	35.00
21	3.71000	3.68000	34.750	20.6875	168s	35.00
22	3.72000	3.69000	34.750	Holiday	Holiday	35.00
23	3.70500	3.67500	(*e*)	(*e*)	(*e*)	35.00
25	3.68000	3.65000	34.750	Holiday	Holiday	35.00
26	3.60500	3.57500	34.750	20.0625	168s	35.00
27	3.51250	3.48000	34.750	20 2500	168s	35.00
28	3.55000	3.51750	34.750	20.4375	168s	35 00
29	3.57000	3.53500	34.750	20.4375	168s	35.00
30	3.51500	3.48125	(*e*)	(*e*)	(*e*)	35.00
			AVERAGES FOR MONTH			
Mar.	3.75212	.....	34.750	20.763	....	35 00
Mar.			**AVERAGES FOR WEEK**			
6	3.91125	.....	34.750	.....	....	.....
13	3.84833	.....	34.750	.....	....	.....
20	3.72750	.....	34.750	.....	....	.....
27	3.65542	.....	34.750	.....	....	.....

Calendar week averages: New York Silver; 2nd, 34.750; 9th, 34.750; 16th, 34.750; 23rd, 34.750, 30th, 34.750.

(*e*) Not quoted (Saturday).

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1940	COPPER			TIN		LEAD				ZINC			
	Standard		Electro	Standard		Spot		3 months		Spot		3 months	
March	Spot	3 months	Bid	Spot	3 months	Buyers	Sellers	Buyers	Sellers	Buyers	Sellers	Buyers	Sellers
1	Not quoted			252.7500	252.5000	Not quoted							
4	"	"		251.7500	251.5000	"	"						
5	"	"		254.2500	253.5000	"	"						
6	"	"		255.0000	254.0000	"	"						
7	"	"		255.2500	254.7500	"	"						
8	"	"		256.2500	255.5000	"	"						
11	"	"		258.0000	257.0000	"	"						
12	"	"		256.7500	255.7500	"	"						
13	"	"		254.7500	253.7500	"	"						
14	"	"		252.5000	251.7500	"	"						
15	"	"		251.7500	250.0000	"	"						
18	"	"		248.0000	246.0000	"	"						
19	"	"		247.7500	246.2500	"	"						
20	"	"		248.7500	247.2500	"	"						
21	"	"		250.2500	248.5000	"	"						
22	"	"		Holiday	Holiday	"	"						
25	"	"		Holiday	Holiday	"	"						
26	"	"		247.2500	245.2500	"	"						
27	"	"		245.5000	243.7500	"	"						
28	"	"		247.7500	246.000	"	"						
29	"	"		248.2500	246.000	"	"						
Average for month				251.711									

Prices for tin are the official prices of the London Metal Exchange, in long tons (2240 lb.). Trading in other metals remained suspended.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(April 1, 1940)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	19c.
Antimony, domestic, spot, lb	14.00c.
Bismuth, ton lots, lb	$1.25
Cadmium, commercial sticks, lb	80c.
Calcium, lb., ton lots 97 @ 98 per cent	Nominal
Chromium, 97 per cent grade, lb	89c.
Cobalt, 97 to 99 per cent, per lb	$1.50
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	27c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$40.00
Quicksilver, flask of 76 lb., 100 flasks or more	$180.00
Radium, mg. radium content	$25.00@$30.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 48 @ 50% Cr_2O_3 c.i.f. Atl. ports, long ton	$29.00@$30.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$5.25
Mesabi bessemer	$5.10
Old Range non-bessemer	$5.10
Mesabi, non-bessemer	$4.95
Lead (Galena) 80 per cent, Joplin, Mo., ton	$55.50@$60.50
Manganese Ore, c.i.f. Atlantic ports, long ton unit of Mn:	
52 @ 55 per cent	(b) 49c.
50 @ 52 per cent	(b) 49c.
44 @ 48 per cent	(b) 46c.
Molybdenum Ore, 90%, per lb. of MoS_2, f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	$23.00
Domestic, 65 per cent and upward	(a)$21.00@$23.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$37.50

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3c.
Cobalt Oxide, 70 @ 71 per cent, lb	$1.84
Copper Sulphate, 100 lb	$4.60
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.42
Sodium Sulphate, bulk ton	$13.00@$15.00

ALLOYS

Berryllium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb	11c.
Ferromanganese, 78 @ 82 per cent, gross ton	$100.00
Ferromolybdenum, 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 per cent, gross ton	$69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.90@$2.00

NON-METALLIC MINERALS

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$45
Shorts	$12@$16.50
Vermont	
Shingle stock	$57
Paper stock	$40
Cement stock	$25
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$6.50
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$6.00@$7.00
Domestic, abrasive, 80 @ 84 per cent	$13.00@$14.00
Dalmatian, 50 @ 55 per cent	Nominal
French, 56 @ 59 per cent	(a)$7.00@$8.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$14.50
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$21.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00
Dead-burned, f.o.b. Washington	$22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in.	30@35c.
2 x 2 in.	50@60c.
3 x 3 in.	$1.25@$1.35
3 x 4 in.	$1.50@$1.60
3 x 5 in.	$1.75@$2.00
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12c.
Silica, in bags, 325 mesh, ton	$18.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$9.00@ $9.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$23.50
Basic	$22.50
No. 2 Foundry	$23.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$34.00
Structural shapes, 100 lb	$2.10
Bars, 100 lb	$2.15

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1939	1940	1939	1940	1939	1940
January	42.750	34.750	20.305	21.892	466.775	395.442
February	42.750	34.750	20.370	20.935	468.472	395.652
March	42.750	34.750	20.280	20.763	468.370	375.212
April	42.750	.....	20.031	.....	467.778	.....
May	42.750	.....	20.123	.....	467.988	.....
June	41.955	.....	19.505	.....	468.137	.....
July	34.944	.....	16.952	.....	468.031	.....
August	35.951	.....	17.719	.....	460.383	.....
September	36.956	.....	22.178	.....	398.820	.....
October	35.726	.....	22.736	.....	400.350	.....
November	34.750	.....	23.378	.....	391.457	.....
December	34.956	.....	23.263	.....	391.830	.....
Year	39.082	.....	20.570	.....	443.199	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine, London pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		Electrolytic (a)	
	1939	1940	1939	1940	1939	1940	1939	1940
January	11.025	11.954	9.912	11.999	43.125	(b)	48.440 (2)	(b)
February	11.025	11.148	9.735	11.471	42.188	(b)	47.375	(b)
March	11.025	11.160	9.888	11.407	42.938	(b)	48.120	(b)
April	10.265	.....	9.820	.....	42.031	.....	47.853	.....
May	9.833	.....	9.738	.....	41.656	.....	47.528	.....
June	9.775	.....	9.738	.....	41.986	.....	47.528	.....
July	9.976	.....	9.944	.....	42.899	.....	48.863	.....
August	10.261	.....	10.211	.....	44.685	.....	50.409	.....
September	11.635	.....	11.685	.....	(b)	.....	(b)	.....
October	12.215	.....	12.491	.....	(b)	.....	(b)	.....
November	12.275	.....	12.929	.....	(b)	.....	(b)	.....
December	12.275	.....	12.631	.....	(b)	.....	(b)	.....
Year	10.965	.....	10.727	.....	(c)42.689	.....	(c)48.262	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotations. (b) No quotations. (c) Average for eight months.

LEAD

	New York		St. Louis		London			
	1939	1940	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.826	5.471	4.676	5.321	14.534	14.744	(a)	(a)
February	4.805	5.076	4.655	4.926	14.283	14.417	(a)	(a)
March	4.824	5.192	4.674	5.042	14.660	14.860	(a)	(a)
April	4.782	.....	4.632	.....	14.337	14.533	.....	.....
May	4.750	.....	4.600	.....	14.483	14.679	.....	.....
June	4.800	.....	4.650	.....	14.564	14.651	.....	.....
July	4.854	.....	4.704	.....	14.753	14.856	.....	.....
August	5.043	.....	4.893	.....	16.040	15.885	.....	.....
September	5.449	.....	5.299	....	(a)	(a)	.....	.....
October	5.500	.....	5.350	.....	(a	(a)	.....	.....
Novemoer	5.500	.....	5.350	.....	(a)	(a)	.....	.....
December	5.500	.....	5.350	.....	(a)	(a)	.....	.....
Year	5.053	.....	4.903	....	(b)14.707	(b)14.828	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton. (a) No quotations. (b) Average for eight months.

TIN

	Straits New York		Standard, Spot London	
	1939	1940	1939	1940
January	46.404	46.707	215.435	240.716
February	45.640	45.851	213.906	242.833
March	46.213	47.079	215.375	251.711
April	47.160	.....	218.389	.....
May	49.031	.....	225.591	.....
June	48.853	.....	227.511	.....
July	48.548	.....	229.833	.....
August	48.793	.....	229.869	.....
September	64.588	.....	229.292	.....
October	55.580	.....	229.943	.....
November	52.322	.....	230.000	.....
December	50.740	.....	248.974	.....
Year	50.323	.....	226.177	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.500	5.644	13.682	13.887	(a)	(a)
February	4.500	5.534	13.522	13.780	(a)	(a)
March	4.500	5.750	13.728	13.961	(a)	(a)
April	4.500	.....	13.443	13.637	.....	.....
May	4.500	.....	13.717	13 938	.....	.....
June	4.500	.....	14.023	14.223	.....	.....
July	4.516	.....	14.235	14.435	.....	.....
August	4.719	.....	14.628	14.761	.....	.....
Septemter	6.104	.....	(a)	(a)	.....	.....
October	6.500	.....	(a)	(a)	.....	.....
November	6.500	.....	(a)	(a)	.....	.....
December	5.980	.....	(a)	(a)	.....	.....
Year	5.110	.....	(b)13.872	(b)14.078	.....	.....

St. Louis quotations, Prime Western, cents per pound. London, pound sterling per long ton. (a) No quotations. (b) Average for eight months.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1939 (a)	1940 (a)	1939	1940
January	58.400	79.038	20.000	20.000
February	55.000	80.000	20.000	20.000
March	54.259	80.000	20.000	19.769
April	50.000	.....	20.000	.....
May	50.000	.....	20.000	.....
June	50.000	.....	20.000	.....
July	50.000	.....	20.000	.....
August	53.704	.....	20.000	.....
September	64.200	.....	20.000	.....
October	74.600	.....	20.000	.....
November	75.000	.....	20.000	.....
December	75.000	.....	20.000	.....
Year	59.180	.....	20.000	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound. (a) Producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1939	1940	1939	1940	1939	1940
January	11.670	14.000	77.440	156.962	34.440	40.000
February	11.250	14.000	85.227	178.000	35.000	40.000
March	11.269	14.000	87.278	180.921	35.000	40.000
April	11.500	.....	90.800	.....	35.000	.....
May	11.712	.....	86.769	.....	35.000	.....
June	12.000	.....	86.615	.....	35.000	.....
July	12.000	.....	86.960	.....	35.000	.....
August	12.000	.....	84.407	.....	35.333	.....
September	12.910	.....	140.000	.....	40.080	.....
October	14.000	.....	145.600	.....	41.120	.....
November	14.000	.....	134.978	.....	40.000	.....
December	14.000	.....	141.200	.....	40.000	.....
Year	12.359	.....	103.940	.....	36.748	.....

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk 13,415 for February. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum, dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1939	1940	1939	1940	1939	1940
January	21.50	23.50	20.50	22.50	21.00	23.00
February	21.50	23.50	20.50	22.50	21.00	23.00
March	21.50	23.50	20.50	22.50	21.00	23.00
April	21.50	.....	20.50	.....	21.00	.....
May	21.50	.....	20.50	.....	21.00	.....
June	21.50	.....	20.50	.....	21.00	.....
July	21.50	.....	20.50	.....	21.00	.....
August	21.50	.....	20.50	.....	21.00	.....
September	22.50	.....	21.50	.....	22.00	.....
October	23.50	.....	22.50	.....	23.00	.....
November	23.50	.....	22.50	.....	23.00	.....
December	23.50	.....	22.50	.....	23.00	.....
Year	22.083	.....	21.083	.....	21.583	.....

Iron, dollars per long ton. F.o.b. Mahoning and Chenango Valley furnaces.

PERSONAL ITEMS

Robert L. Schell, Wheaton, Ill., has gone to Matagalpa, Nicaragua, with Compañia Minas Matagalpa.

Frank C. Appleyard, Midland, Calif., is in the employ of Braden Copper Company, Rancagua, Chile.

Hugh Leach has joined the engineering department of Oliver Iron Mining Company at Coleraine, Mich.

Arnold H. Miller, vice-president in charge of operations of Certain-teed Products Corporation, has been elected a director of that company.

Milton Serman, mining engineer, recently with Pickands, Mather & Company, has joined the staff of Phelps Dodge at Morenci, Ariz.

W. L. Cumings, mining engineer, also recently with Pickands, Mather & Company, has resigned to take up mining work in South America.

Rudolph C. Gebhardt, geologist for E. J. Longyear & Company, has joined the staff of Cleary Hill Mines Company at Fairbanks, Alaska.

John H. Davis, mining engineer for Phelps Dodge Corporation, Douglas, Ariz., has been appointed manager of the Ajo division at Ajo, Ariz.

R. V. McAllister, formerly chemist and assayer for Keystone Mines, Inc., Kingman, Ariz., has opened an assay and metallurgical office in Kingman.

John Kellogg, formerly in charge of the Erin-Go-Bragh mine at Stent, Calif., has been named superintendent for LeRoi Mines, Inc., Jackson, Calif.

Willard Van Doren has been appointed mine superintendent of Original Sixteen-to-One Mine, Inc., succeeding the late Charles A. Godfrey.

Samuel H. Dolbear, president of Wright, Dolbear & Company, consulting mining engineers, has been elected a trustee of Clark University at Worcester, Mass.

H. E. McKinstry moved from New York to Madison, Wis., in February to take up his duties as acting professor of geology at the University of Wisconsin.

L. Roth Harrison, Jr., has resigned his position as metallurgist for the Phosphate Recovery Corporation at Mulberry, Fla., to accept the position of production manager of the Magnet Cove Barium Corporation at Malvern, Ark.

Fred W. Sherman on March 1 became superintendent of Kern Mines, Inc., at Kernville, Calif. under the supervision of **Dr. John W. Prout,** Jr. Mr. Sherman succeeds **Eivind Knutsen** as superintendent.

Robert William Wilson, after spending five months in Peru on mine examinations, has been put in charge of the silver-lead property, Empresa Minera Chilcane, between Potosi and Sucre, Bolivia, acquired by Mauricio Hochschild, S.A.

Joseph Errington, of Toronto, is the president of Steep Rock Iron Mines, Ltd., the property of which, in northwestern Ontario, is shown in the photographs on pages 46 and 47 of this issue. Mr. Errington is president also of Little Long Lac Gold Mines, Ltd., and is an officer or director in various other Canadian mining companies.

JOSEPH ERRINGTON

W. F. Boericke recently examined manganese deposits on the Siquijor Island, P. I. Hand mining methods are used in this work. Siquijor Island has shipped about 40,000 tons of manganese ore since 1938. A mill has recently been built at the property.

George C. Bateman was elected president of the Canadian Institute of Mining and Metallurgy at the meeting of the Institute held in Winnepeg on March 11. He succeeds **B. L. Thorne.** Mr. Bateman has for many years been secretary of the Ontario Mining Association.

Roland D. Parks, associate professor of mining engineering at Michigan College of Mining and Metallurgy, has resigned from that post to become a member of the faculty of Massachusetts Institute of Technology, where he will teach courses in mining engineering.

Dr. R. R. Sayers, of the United States Public Health Service, was on April 5 appointed acting director of the Bureau of Mines by **Harold L. Ickes,** Secretary of the Interior. He succeeds **Dr. John W. Finch.**

William T. Burns, chemist and mineralogist, and recently United States Territorial Assayer at Fairbanks, Alaska, has joined the staff of Imperial Gold Mines, Inc., as an engineer and geologist at the company's property at Gold Hill, Oregon.

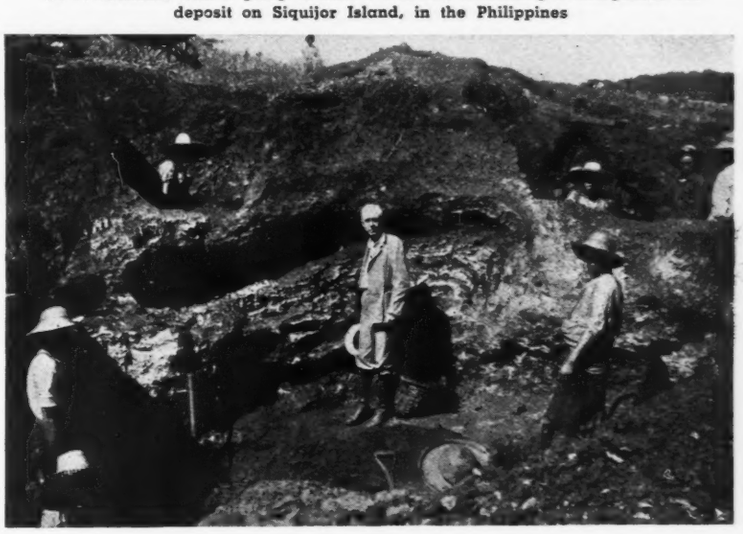
L. E. Whicher, treasurer of Copper Canyon Mining Company, recently left New York for a visit to the company's properties at Battle Mountain, Nev., stopping, also, at Los Angeles, San Francisco, Reno, and Salt Lake City.

R. S. Dean, chief engineer of the metallurgical division of the United States Bureau of Mines in Salt Lake City, has returned to Salt Lake from a six weeks' business trip to New York City, Washington, and Detroit, Mich.

Earl F. Nieman, who was manager for the Columbia Mines, Inc., when that company shipped a large tonnage of high-grade ore from property in northwestern Humboldt County, Nev., is now superintendent for the Ohio-Eagle Mines, Inc., shipping several carloads weekly from its gold-silver property near Rebel Creek in the same county.

Fremont E. Wood has resigned his position as mechanical-electrical superintendent for the Cuban Mining Company, which is the Cuban subsidiary of the Freeport Sulphur Company, a posi-

W. F. Boericke, with a group of native workers, examining a manganese ore deposit on Siquijor Island, in the Philippines



tion which he has held for the last seven years, to accept a similar post with the Minas de Matahambre.

W. A. Wasley, metallurgical superintendent for the Fresnillo Company, Fresnillo, Zacatecas, Mexico, resigned recently to accept the position of surface superintendent with the Mexican Candelaria Company, Contra Estaca, Sinaloa, Mexico.

W. R. Wade left San Francisco March 15 for his gold mining property, the Branagan mine, near Libby, Mont. He will resume development on his property this spring and expects to begin construction of a new 125-ton flotation-amalgamation mill, to treat its ores about June 1, 1940. His address for the summer months will be Libby, Mont.

Fred M. Veatch has been transferred from the position of district engineer of the United States Geological Survey district office in Kentucky to the same position at Tacoma, Wash., and **Joseph V. B. Wells** has discontinued his water resources investigational work in Pennsylvania and has gone to Louisville, Ky., where he will fill Mr. Veatch's vacated post.

Louis F. Hanley, former vice-president and superintendent of Hecla Mining Company in the Coeur d'Alene district of Idaho, has been elected president-manager of the company to succeed the late James F. McCarthy, notice of whose death was recorded in the March issue of *Engineering and Mining Journal*. Mr. Hanley was also elected president of the Polaris Mining Company, of which Mr. McCarthy had been president.

Glenville A. Collins, mining engineer, has established offices at Room 102 Belmont House, Victoria, B. C., and is principally engaged in scouting for dredge property for General Dredging Corporation, of Sacramento, Calif. He recently organized Gold River Mines, Ltd., a British Columbia company which has acquired quartz property on Gold River south of Zeballos on the west coast of Vancouver Island. The company will develop the property this summer. It was located by Mr. Collins two years ago.

▼ ▼ ▼

OBITUARY

Beriah Magoffin, of Deerwood, Minn., prominently identified with the pioneering of the Cuyuna Range, died on March 15.

William A. Eaton, of Los Angeles, formerly active in mine promotion on the Mesabi and Vermilion iron ranges, died on March 18 at the age of 72.

Major G. A. Harrison, formerly general manager of New Guinea Goldfields, Ltd., Wau, New Guinea, died on Oct. 29 at the age of 63.

Webb Smith, superintendent of the Kennedy mine, at Jackson, Calif., until his retirement a few years ago, died recently in Sacramento, Calif., aged 83.

Prof. Waldemar Christopher Broögger, eminent Scandinavian scientist and geologist, died at Oslo, Norway, on Feb. 19 last, at the age of 89.

Frank V. Johnson, mine superintendent of Cactus Mines, Inc., near Mojave, Calif., and for many years a member of the staff of the Kennett, Calif., and Gold Road, Ariz., units of U. S. Smelting Refining & Mining Company, died recently at Rosamond, Calif.

John McDermott died in Sydney, New South Wales, on December 16 last, aged 74 years. Mr. McDermott, who went to Western Australia from New Zealand in 1894, was superintendent of the Sons of Gwalia mine, Leonora, W. A., from 1906 to 1912. Going to Rhodesia, he returned to Australia in 1917 as general manager of the Ivanhoe mine, Kalgoorlie. He had been living in retirement in Sydney for the past ten years.

Gibson T. Berry, president and general manager of the Bingham Metals Company, operating in the Bingham district of Utah, died on Feb. 23 in Salt Lake City. He was 55 years old. From 1916 to 1928 Mr. Berry was mining engineer for the Round Mountain Mining Company. In the latter year he became superintendent of International Smelting properties at Heber City. He became associated with Bingham Metals in 1930.

Frederick R. Koeberlin, 63, consulting mining geologist, who had for many years made his professional headquarters in Santiago, Chile, died on board the Grace liner "Santa Clara" on March 21, while the ship was off the coast of Peru en route from the United States to Southern ports. Mr. Koeberlin was returning to Chile after a visit to this country. He had made a specialty of tin properties for more than twenty years. He was an alumnus of the Missouri School of Mines and Columbia University.

Louis Davidson Ricketts

An Appreciation

Dr. Louis Davidson Ricketts, whose death on March 4, 1940, was reported briefly in last month's issue, was for years a leading figure in the copper industry. In twenty years, 1897-1916, he was identified with such prominent companies as Montezuma Copper Company, Detroit Copper Company, Old Dominion Copper Mining & Smelting Company, Cananea Consolidated Copper Company, Calumet & Arizona Copper Company, Arizona Copper Company, Ltd., Inspiration Consolidated Copper Company, New Cornelia Copper Company, and United Verde Extension Mining Company. In the development of many of these enterprises he was consulting engineer to Phelps Dodge Copper Corporation, and Anaconda Copper Mining Company.

The largest and most successful copper concentrators and smelters of his time were designed and built under his direction, and it was generally recognized that no other individual did as much as he to promote and build the mining industry in the Southwest. In his various undertakings he directed the expenditure of more than $40,000,000 for new mills and smelters, introducing improved methods that increased metal recovery and decreased unit costs.

Dr. Ricketts began his extraordinary career as a mine surveyor. He was graduated from Princeton in 1881 and was appointed W. S. Ward Fellow in Economic Geology. One of the provisions of the fellowship was that the recipient should spend half the year at mines in Leadville under the control of Mr. Ward. As a result, he wrote his doctor's thesis on "The Ores of Leadville and Their Mode of Occurrence." After graduation he worked in Colorado mines until 1887, when he was appointed State Geologist of Wyoming. But in 1890 he became consulting engineer for Phelps Dodge and was thereafter engaged in developing the copper industry of the Southwest.

In 1916 Dr. Ricketts was president of the A.I.M.E., and on his death the Board of that organization paid him tribute, saying, among other things, "Few engineers have shown such courage in advising investments on the results of their experiments, where the methods outlined were at variance with standard practice; and none was more modest in receiving the acclaim resulting from the success of these developments, and none more insistent that the credit belong to his staff than was Dr. Ricketts. Preeminent as Doctor Ricketts was as an engineer, geologist, and metallurgist, he was even more respected by the profession and his associates as a helpful, understanding friend."

At a meeting of the board of directors of Phelps Dodge Corporation held March 6, 1940, the following resolution was unanimously adopted by a standing vote:

The board of directors of Phelps Dodge Corporation record, with deep sorrow, the death on March 4, 1940, of their esteemed friend and associate, Dr. Louis D. Ricketts.

From 1890 until 1906 Dr. Ricketts was identified with Phelps Dodge & Company in consulting and managerial capacities. In 1897 he designed a concentrating plant for the company's property at Morenci, Arizona. In the same year he designed a similar plant for the property at Nacozari, Sonora, Mexico, and from 1899 to 1901 he served as manager of that property. In 1901 he successfully undertook the rehabilitation of the plant and mines of the Old Dominion Company at Globe, Arizona. In 1905 he designed and installed the coal-washing plant for the company at Dawson, New Mexico.

Dr. Ricketts' reputation as an engineer and metallurgist having become widely recognized, he was engaged as a consultant for other companies, some of which were subsequently acquired by, and now form part of, Phelps Dodge Corporation. These include the Arizona Copper Company, the Calumet & Arizona Mining Company, and the New Cornelia Copper Company. The Arizona Copper Company retained Dr. Ricketts in 1912 as consultant in the design and construction of a smelting plant at Clifton, Arizona, and in remodeling its concentrator at Morenci, Arizona. He also acted as consultant in the design and construction in 1911 of a new smelting plant at Douglas, Arizona, for the Calumet & Arizona Mining Company. Under Dr. Ricketts' direction, during 1914–1917, a process for treating the oxidized ore of the New Cornelia Copper Company at Ajo, Arizona, was developed and successfully applied in a 5,000-ton bleaching plant which was completed in 1917 and was one of the first of its kind in the world.

Shortly before his death Dr. Ricketts was awarded the James Douglas Medal by the American Institute of Mining and Metallurgical Engineers for "Inspirational leadership and distinguished achievements in the metallurgy of copper." His reputation was international. In 1910 he received the gold medal of the Institution of Mining and Metallurgy, London, England, for his paper on "Experiments in Reverberatory Practice at Cananea."

Dr. Ricketts was a man of outstanding character, of great personality, and of rare attainments as an engineer and metallurgist. His loss will be keenly felt by his fellow directors and friends in Phelps Dodge Corporation.

Resolved, That this resolution be recorded in the minutes of this meeting and a copy be forwarded as an expression of heartfelt sympathy to Dr. Ricketts' family.

LOUIS S. CATES,
President
GEO. R. DRYSDALE,
Secretary

What Metal Statistics Show

PRODUCTION of copper, lead, and zinc was steadily maintained during March. With consumption of these metals still continuing on a fair basis, producers believe their statistical position is not unwieldy, as stocks have increased only moderately since the first of the year. Export copper business has declined, and with only a moderate volume of new orders coming in to domestic copper fabricators, cautious policies predominate in the industry. Early in April, however, a higher stock market offered a basis for a firmer undertone in non-ferrous metals, but sales in the industry remained modest.

Copper production of the British Empire is now estimated at a rate above 600,000 tons annually, against 80,600 tons in 1913 before the previous European war.

The following accounting of world production of copper by the American Bureau of Metal Statistics is on the basis of smelter output, excluding secondary copper. The major part of the production for 1939 has been reported, but some figures are conjectural. The figures are in short tons.

	1938	1939
United States, domestic ore	553,430	745,000
United States, foreign ore	74,672	(a)67,800
Mexico	40,870	(b)46,700
Canada	238,052	252,600
Chile	372,046	357,800
Peru	39,230	37,500
Finland	13,034	14,500
Germany, inc. Austria	75,838	73,000
Great Britain	4,409	(c)5,000
Norway	11,572	12,500
Russia (c)	108,000	118,000
Spain	10,100	8,000
Sweden	11,759	12,000
Yugoslavia	46,288	45,900
Other Europe	11,000	16,000
Turkey (b)	2,500	5,000
Japan	111,300	(c)119,000
India	6,000	7,500
Other Asia	4,500	(c)6,000
Australasia	19,105	23,400
Africa (d)	386,042	383,600
Totals	2,140,135	2,356,800
Whereof United States	553,430	745,000
Outside United States	1,586,705	1,611,800

(a) Copper content (95 per cent) or ore and matte imported, including receipts from Cuba and the Philippines, admitted duty free. (b) Imports of blister copper into the United States. (c) Conjectural. (d) Comprise Belgian Congo, including Katanga matte smelted in Belgium, Rhodesia, and Union of South Africa.

Exports of refined copper from the United States, consisting of foreign metal refined in bond and domestic copper, during January and February, in short tons, according to the Department of Commerce, were as follows:

To:	Jan.	Feb.
Belgium	280	112
Denmark	504	50
France	6,446	10,470
Germany	....	....
Great Britain	420	2,060
Hungary	794	2,188
Italy	5,114	3,598
Netherlands	1,149	632
Russia	26,603	6,408
Sweden	549	2,649
Switzerland	1,740	2,075
China and Hongkong	151	137
Japan	12,604	2,468
Other countries	1,250	2,809
Totals	57,604	35,656

▶LEAD—The February statistics of the lead refineries of this country showed stocks at the end of the month of 72,658 tons, a gain of 4,119 tons compared with the figures for a month previous.

Domestic shipments for February amounted to 39,176 tons, against 39,875 tons in January and a monthly average of 46,256 tons for all of 1939.

The January and February statistics, in tons, follow:

	Jan.	Feb.
Stock at beginning	58,777	68,539
Production:		
From domestic ore	47,149	40,564
Secondary and foreign	2,534	2,753
Totals	49,683	43,317
Domestic shipments	39,875	39,176
Stock at end	68,539	72,658

E & M J Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922–3–4)

1929	110.33	1934	69.59
1930	82.87	1935	74.66
1931	60.20	1936	73.45
1932	48.26	1937	90.86
1933	59.79	1938	73.67
1939	77.71		

	1938	1939	1940
January	75.56	77.12	80.85
February	73.43	76.89	77.23
March	72.41	77.09	77.94
April	71.19	74.79	.....
May	69.15	73.61	.....
June	67.55	73.17	.....
July	72.95	71.95	.....
August	73.94	73.88	.....
September	74.70	83.07	.....
October	77.61	84.25	.....
November	78.36	83.80	.....
December	77.13	82.89	.....

Preliminary estimates on world lead production, on refinery basis, with various figures necessarily wholly conjectural because of war conditions, according to the American Bureau of Metal Statistics, in short tons, follow:

	1938	1939
United States (a)	381,849	462,200
Canada	203,093	195,400
Mexico	228,261	191,300
South America	39,545	39,900
France	48,055	55,000
Germany, inc. Austria	204,145	200,000
Italy	47,741	42,000
Poland	14,398	18,000
Yugoslavia	9,610	11,800
Other Europe (b)	236,400	236,000
Australia (c)	250,524	263,000
Burma	89,712	86,666
Tunis	26,203	25,817
Elsewhere (d)	66,100	77,800
Totals	1,845,636	1,904,883

(a) Exclusive of lead refined from imported ore and base bullion and inclusive of some secondary lead. (b) Inclusive of Belgium, Great Britain, Russia, and Spain. (c) Inclusive of Australian base bullion refined in Great Britain. (d) Mostly lead from foreign ore and base bullion smelted and refined in the United States, but inclusive of an estimate for Japan.

▶ZINC—The January, February, and March statistics of the American Zinc Institute, covering all grades, are summarized as follows in tons:

	Jan.	Feb.	March
Stock at beginning	65,995	65,602	67,086
Production	57,158	54,532	57,620
Production daily rate	1,844	1,880	1,859
Shipments	57,551	53,048	51,095
Untilled orders	36,808	47,496	34,580
Stock at end	65,602	67,086	73,611

Figures covering operations of the Prime Western division, for January, February and March, follow:

	Jan.	Feb.	March
Stock at beginning	30,052	26,812	28,484
Production	24,689	23,687	25,103
Shipments	27,929	22,015	21,408
Stock at end	26,812	28,484	32,179

United States Duty-Free Copper Statistics

(Copper Institute)

In Short Tons

		(a)Production Crude	Production Refined	Deliveries to Customers Domestic	Deliveries to Customers Export	Deliveries to Customers Totals	(b)Stocks, Refined
Year	1935	.....	.....	.....	.....	.....	231,415
Year	1936	731,629	748,660	764,560	54,447	819,007	161,068
Year	1937	982,045	964,176	803,095	62,798	865,893	259,351
Year	1938	644,869	638,076	481,803	125,869	607,672	289,755
Year	1939	(c)836,074	818,289	814,407	134,152	948,559	159,485
January	1939	.....	.....	.....	.....	.....	301,244
February	1939	60,707	59,452	48,267	3,310	51,577	309,119
March	1939	61,752	66,718	50,803	4,222	55,025	320,812
April	1939	62,548	58,368	42,484	4,183	46,667	332,513
May	1939	58,600	68,536	51,225	12,669	63,894	337,155
June	1939	59,672	61,719	53,573	10,289	63,862	335,012
July	1939	54,850	57,339	59,681	16,127	75,808	316,543
August–December	1939	(c)408,775	379,841	457,315	79,584	536,899	159,485
January	1940	(c) 89,598	(c) 80,501	91,428	(c) 13,117	(c)104,545	135,441
February	1940	76,194	82,761	63,215	9,594	72,809	145,393

(a) Mine or smelter production or shipments, and custom intake, including scrap. (b) At refineries, on consignment, and in Exchange warehouses, but not including consumers' stocks at their plants or warehouses. (c) Corrected.

CALIFORNIA

Tecopa Silver-Lead Mine Ready for Production

Property has been idle for many years—gold dredging, placer operations, and hydraulicking get under way as weather conditions permit

▶ Mining operations are scheduled to start soon at the Tecopa properties, situated partly in Inyo County and part in San Bernardino County, acquired recently under lease by Tecopa Consolidated Mining Company, headed by Arizona and Nevada interests. Owned for many years by Dr. L. D. Godshall, the mines at one time were the largest lead-silver producers in California and have lain idle since suspension of work in the early 20's. Subsequent incidental development work has opened a substantial tonnage of commercial ore, and the new operators are completing plans for systematic exploitation.

▶ Dredging operations have been resumed at Oroville, Yuba County, by the Golden Feather Dredging Company, following reconstruction of the dredge which capsized last November. The work is directed by H. Kumle, manager.

▶ The old Guatemala gravel mine, near Downieville, Sierra County, had been opened up for mining when miners active in the adjoining Ruby mine unexpectedly broke into an old tunnel in Guatemala ground. Operation of the Guatemala and near-by Golden Bear mine, another old producer long idle, in conjunction with the Ruby, is planned by the management. L. I. Huelsdonk, manager, directs operation at the Ruby property, and about 30 men are employed.

▶ Alhambra-Shumway Mines, Inc., of Fresno, on March 15 made two additional dividend payments of 5c. each, bringing the total paid so far to 125 per cent. The company operates the famous Alhambra mine, near Kelsey, El Dorado County, which has produced $700,000 in a relatively short time, and the Veercamp property, in Garden Valley. At both properties shaft-sinking operations are now in progress. The shaft at the Alhambra is being deepened an additional 200 ft., and at the Veercamp the shaft has reached a depth of 150 ft., which stations cut at 50 and 100 ft. and drifting in progress on the 150 level. C. E. Halliburton is secretary-treasurer of the company, Ray Henrickson, superintendent, and A. R. McGuire, engineer.

▶ Development work is in progress at the Granite King mine, at Buckeye, Mariposa County, recently taken under option from M. T. and E. McElligott by Greenamyer Brothers, of Los Angeles. The mine has been operated steadily during the past two years by Mr. McElligott, with good ore reported developed. A mill may be erected by the new operators later.

▶ Hydraulic mining operations are to be resumed early in April at the Poverty Hill mine, at Strawberry Valley, Yuba County, following a brief shutdown because of adverse road and weather conditions. The property is owned by Alfred J. Oyster, of San Francisco, with Army Adams directing operations. Last year the mine was operated successfully from July 1 to January, 1940.

▶ New grinding equipment is to be added to the 18-stamp mill at the property of Comet Quartz Mines, Inc., near San Andreas, Calaveras County, where exploitation of surface ore by open-pit methods has been in progress for several months. Current underground development work includes drifting in two shafts sunk recently. J. M. Lucientes is president of the company.

▶ Development work is progressing at the Golden Oak mine, in the Garden Valley area of El Dorado County, operated under lease by Russell J. Wilson. A crew of twelve men is employed dewatering the 90-ft., two-compartment shaft and exploring territory on the 50-ft. level rehabilitated recently. Ore from development is trucked to the Black Oak mill, in Garden Valley. The main shaft may be deepened if sufficient values are found on the 90-ft. level.

▶ Following dewatering of the Nassau copper mine at Poole Station, Calaveras County, a crew of ten men is reported to be at work rehabilitating underground workings and surface structures. Development consists of a 240-ft. shaft, and levels at 90 and 180 ft. The property is operated by H. E. Bush and associates of San Francisco, who plan to ship ore to the Anaconda smelter at Great Falls.

▶ A contract has been let by Thurman Gold Dredging Company, 960 Russ Building, San Francisco, for a 7-cu.ft. dredge to be operated on the old Saeltzer ranch, on the north bank of Clear Creek near Redding, Shasta County. The new unit will be constructed by Yuba Manufacturing Company, of San Francisco, and is expected to be in operation sometime in November. C. H. Thurman is president of the company.

▶ Dredging operations have been resumed recently at La Grange, Stanislaus County, by Tuolumne Gold Dredging Corporation, following installation of improved equipment, including a Yuba sand pump system, on the 12-cu.ft. dredge financed through a $600,000 R.F.C. loan and placed in operation during 1938. M. L. Summers is superintendent and E. I. Bean, dredge master.

▶ New Almaden Corporation, formed recently in Philadelphia, has registered with the S.E.C. for permission to sell 50,000 shares, each of $10, to raise $500,000 for the rehabilitation of, and production of quicksilver from, the New Almaden mine. F. Eugene Newbold, of Newbold's Son & Company, Philadelphia, is president of the new corporation, and C. N. Schuette, of San Francisco, consulting engineer, is general manager at New Almaden. The lease is for 35 years with two five-year extensions. Open-pit mining as well as underground exploration will start following approval by S.E.C. to sell the stock. Ore will be reduced on the property and quicksilver recovered will be sold by the corporation.

ARIZONA

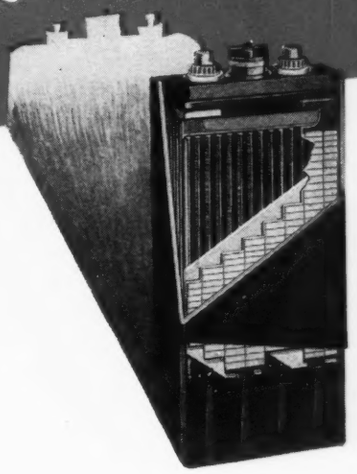
Large Stripping Program Advances at Morenci

Phelps Dodge Corporation reports that 25,000,000 tons of waste rocks must be removed before mining operations begin—Inspiration Consolidated Copper Company produced more than 2,000,000 tons ore in 1939

▶ In the annual report of the Phelps Dodge Corporation for 1939, Louis S. Cates, president, stated that at the Bisbee mines of the Copper Queen Branch, the Campbell, Junction, Cole, and Sacramento divisions of the Limestone mines, produced 698,241 tons of ore. More exploration work was done in the past year in areas away from known orebodies than in previous years. On the Dallas fault zone in the Cole mine there have been some particularly promising developments. The area east of the Campbell fault has proved to be excessively wet and preparations are under way to install increased pumping facilities and to drain at a faster rate than in the past. The average rate of pumping from the Junction shaft was over 6,600 g.p.m. for the entire year. The Campbell shaft was deepened and concreted 381 ft. and the bottom is now 50 ft. below the 2,700-ft. point.

▶ At the Morenci Branch, stripping operations in the open-pit mine continued on schedule. To the end of 1939, a total of 16,567,541 tons had been removed, of which 8,868,278 tons was moved during 1939. There remain approximately 25,000,000 tons of waste to be moved before mining operations commence. Shovel operations were concentrated mainly on the south side of Clay Mountain, in the Colorado and Liverpool areas, opening up benches to meet the railroad construction schedule. The bulk of the waste was used to make fills on the railroad which will connect the open-pit mine with the reduction works. Loading and haulage continued with electric shovels and 22½-cu.yd. dump trucks. A total of 574,212 tons of material was mined from the area in which ore has been exposed in the pit. This work produced 449,548 tons of ore, which was delivered to the test mill by 5-cu.yd trucks. Construction of the railroad was pushed throughout the year. Including the main line and the switchbacks in the pit, approximately 22,900 ft. of track was laid in 1939. Preliminary excavation and grading for the new reduction works was started in November. New pit equipment purchased included two electric shovels and five diesel-electric locomotives, four of which were put in temporary service at Ajo. Test-mill operations were started early in April and continued steadily throughout the year. Tests of old and new equipment were conducted in all units of the concentrator, from which conclusive information is being obtained. Further experimental work on crushing, grinding, classification, and flotation equipment is being continued this year. During the year further work was done

MORE AND MORE BUYERS ARE LOOKING BACK OF THE PRODUCT WHEN THEY BUY



MOST storage batteries look very much alike—on the outside. With jars of black rubber and painted trays of wood or steel, even Exides look very little different from others. And if Exide develops a new size or type, such as the TLM, the ML, the FLM, and the MEH types, it is not many months before other manufacturers have a size to meet the Exide rating.

But what really matters are the things you seldom see—what is inside a cell, and what is back of the product.

Inside an Exide-Ironclad cell you will find a real difference. The construction of an Exide-Ironclad positive plate is unlike that of all others in this country. The active material of the plate is contained in hard rubber tubes slotted horizontally to permit free access of the electrolyte. 12½% more plate surface is exposed to the action of the electrolyte than in the regular flat pasted plate construction of the same dimensions.

This is but one advantage. The active material is so firmly held in place and its loss so greatly retarded that the Exide-Ironclad delivers two to three times the life of a battery with ordinary plate construction. All the inherent advantages of the regular type of lead battery are fully retained—its high power ability, high electrical efficiency, and low internal resistance, with great ruggedness and dependability in addition. Only the Exide-Ironclad can give you all these advantages.

Looking further, you see the company behind the battery, a company that is one of America's great institutions. Started 51 years ago with a small plant and an organization of five men, it consists today of vast factories with many acres of floor space and of assembling plants in principal cities the country over. It is a company grown to be the largest of its kind in the world because of the genuine merit of its products and its reputation for fair dealing.

It has always been devoted exclusively to the manufacture of one product—storage batteries—and its foundation policy has been to build its product for each class of service with the full measure of excellence that its long experience and ample resources could provide.

Behind the product also is a nation-wide service organization, which does not wait for you to call on it, but makes regular and frequent visits to plants in which Exides are used, with the purpose of insuring you the utmost in performance and the longest possible life from the battery.

Today, more and more buyers are looking back of the product before they buy. That is why more and more buy Exide. When you need a battery, don't base your selection on outside appearance only. Look behind it as well as inside—and you, as have thousands of others, will see why your new battery must be an Exide.

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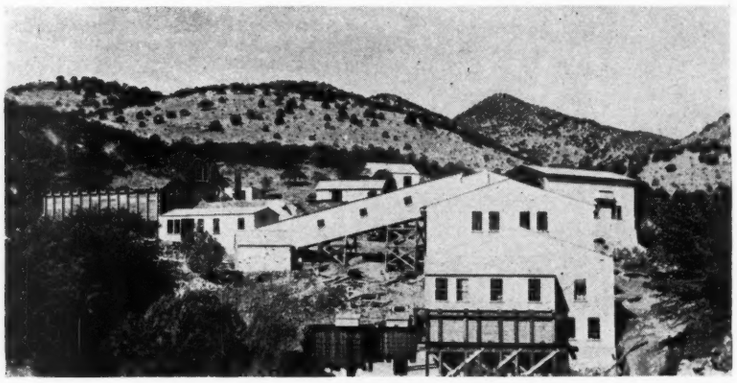

New 100-ton flotation plant of the Callahan Zinc-Lead Company near Duquesne, Ariz. Production is expected to start in April, the plant treating silver, lead, zinc, and copper ore from Kansas, Holland, and Duquesne mines

▶ARIZONA

preparatory to the construction of the new pumping plant on Eagle Creek. Work has also been started on many of the auxiliary facilities which will be required in addition to the new reduction works proper. These include a large amount of additional housing, a new hospital, a nurses' home, and mine change room and office building.

▶At the New Cornelia Branch, operations were continuous during the year with the exception of the usual seasonal shutdown in summer. At the open pit, there were mined 6,113,840 tons of ore and 7,164,148 tons of waste, of which 1,521,400 tons came from the Arkansas Mountain stripping operations. Broken ore reserves were greatly increased during the year. The efficiency of shovel loading increased, blasting practices were improved, and general operating efficiencies were well maintained. During the latter part of the year, four diesel-electric locomotives, purchased for the Morenci Branch, were under test to determine their adaptability to pit haulage. Two additional electric shovels were purchased. The concentrator treated 6,107,206 tons of ore. On this increased tonnage the operating costs were slightly reduced, but the over-all extraction suffered because of a larger proportion of refractory ore treated.

▶The United Verde Branch produced, from the open pit, 227,540 tons of ore. About one-third of the ore tonnage came from the pit proper, the remainder being clean-up ore from the walls. Little ore remains to be recovered, and after it has been won the pit will be operated solely to produce waste for underground stope fill. Shipments of siliceous ore from the Jerome and Hopewell dumps increased sharply to a total of 167,490 tons. The concentrator treated 294,933 tons of ore with improved extraction. Beginning with the second half of the year, only underground ores were concentrated. The smelter treated 851,990 tons of new metal-bearing material. Fuel oil replaced pulverized coal for furnace use. Experiments were started during the second half of the year with bath smelting, but conclusive results will not be obtained for some time.

▶In the annual report by Charles F. Ayer, president of Magma Copper Company, he stated that the average net cost of producing copper after deducting gold, silver, and zinc values was 7.50c. per pound. This cost includes all operating costs, including Arizona taxes, Federal Social Security taxes, depreciation and administrative expenses, but does not include any allowance for mine depletion, capital-stock tax or Federal income taxes. The comparable cost for the year 1938 is 7.75c. a pound. Total sales of refined copper during the year amounted to 45,006,000 lb. This includes the unsold copper at the beginning of the year, 7,003,179 lb., the smelter production in 1939, and 3,417,646 lb. sold in advance for future delivery from the smelter production in 1940. The average selling price received by the company in excess of all commissions and delivery charges on all copper produced in 1939, including the unsold copper at the beginning of the year, was 10.65½c. a pound. The 3,417,646 lb. sold in advance has been made at prices averaging about 12.30c. a pound net. General Manager Koerner reports that during the month of January a diamond-drill hole was drilled south horizontally from the 4,000-ft. level, and at a point approximately 1,225 ft. from the collar of the hole a vein of good width was cut. The sludge assays showed a fair width of good-grade ore. Whether this discovery is of major important can be determined only by a great deal of crosscutting and drifting. Mr. Koerner further reported that a Carrier centrifugal refrigerating machine, together with necessary auxiliary equipment, was purchased and installed on the 4,000 level the latter part of the year. Its operation has lowered the temperatures and humidity on the 4,000 level appreciably, and work there should now be carried on with average efficiency. The mill treated 236,991 tons of copper ore, assaying 5.22 per cent copper, and 67,074 tons of zinc-copper ore, assaying 1.99 per cent copper and 8.09 per cent zinc. There was produced and shipped to a zinc smelter during the year 5,155 tons of zinc concentrates, which assayed 48.63 per cent zinc. At No. 3 hoist a new motor-generator set, with a capacity approximately the same as the one already in operation there, was purchased and installed. During the summer shutdown No. 3 hoist was rebuilt. With the new hoist and additional electrical capacity it is expected to hoist the present load from a depth of 5,000 ft. at a speed of 2,000 ft. per minute.

▶During 1939 the Inspiration Consolidated Copper Company, at Inspiration, Ariz., mined 2,253,484 dry tons of ore assaying 1.289 per cent total copper, of which 0.663 per cent was oxide copper, according to its annual report. The average tonnage of ore mined per working day was 7,437, mined at the rate of 29.7 tons per man-shift. During the last three months of the year, production was at an average rate of 11,076 tons per working day. Of the total mined during the year 112,113 tons came from development work. Operations at the leaching plant continued throughout the year. In the main leaching plant there were treated, by ferric sulphate leaching, 2,254,120 dry tons of ore from which the slimes had been removed. This ore averaged 1.273 per cent total copper, of which 0.641 per cent was in oxidized form. Extraction was 98.44 per cent of the oxide copper and 79.905 per cent of the sulphide copper, or 89.238 per cent of the total copper. The slimes removed from the ore were treated at the concentrator for the recovery of their sulphide copper content by flotation, the tailings from this operation being treated by sulphuric acid leaching in the slimes leaching plant to dissolve the oxide copper. The amount of slimes so treated during the year was 147,693 dry tons, or 6.55 per cent of the ore mined. The average copper content of the slimes was 1.509 per cent, of which 1.020 per cent was in oxidized form. Extraction in the slimes leaching plant was 90.54 per cent of the oxide copper and 16.91 per cent of the sulphide copper, or 77.83 per cent of the total copper in the slimes leached. The copper content of the slimes leaching plant solutions was precipitated on scrap iron, and the resulting cement copper, with cement copper from the stripping of excess wash-water solutions from the main leaching plant, was smelted at the International Smelting & Refining Company's plant at Miami, Ariz. The copper so produced was fire-refined and cast into anodes for the production of starting-sheet copper used as a nucleus for the cathode copper produced at the electrolytic plant. Concentrating operations during the year were confined to the flotation treatment of the slimes. The concentrates contained 46.81 per cent copper, and were smelted at the International Smelting & Refining Company's plant, where the resulting blister copper was cast into starting-sheet anodes. The combined copper recovery from the concentration and leaching of slimes during the year was 82.372 per cent. Total copper recovery from the entire operation of ore and slimes treatment was 88.751 per cent. The production of copper for the year totaled 51,576,333 lb. William D. Thornton is president of the company and Thomas H. O'Brien is vice-president and general manager.

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NEWS FROM Washington

By Special Correspondent

METAL AND MINERAL CONTROL by each industrial nation has become a vital nationalistic policy everywhere but in the United States. Uncle Sam still undertakes to influence trade relations by old methods and they do not seem to be working well.

If further proof were needed, there was ample during March that international relations involve mineral raw material questions. This means that the mining industry of this country is, willy-nilly, being forced into political situations, some of which have important domestic partisan significance also. The trade agreements battle discussed below is one of these.

Dents Hull's Top Hat

PERHAPS no single recent move has so upset the State Department program for trade agreements as has the announcement of the British Government that it intended to control by license the movement of canned fruits and other quasi-luxury foods into the British Isles. This virtually booted Secretary Hull's silk topper into a most unbecoming piece of headgear to wear as he appeared in further support of legislation extending the trade agreement program for three years. It signifies that under present circumstances the trade agreement even with one of our best friends means nothing when the pinch of money controls is felt at home. It practically announces the British intention to disregard the favors granted to the United States in the British-American trade agreement by a system of nominal import controls that are virtually an embargo. The small dollar consideration, perhaps $10,000,000 a year, of this first action is not an indication of small importance so far as policy goes.

The scheme of bilateral trade negotiation with new tariffs of world-wide significance is apparently too slow to meet this new foreign procedure. Uncle Sam urgently needs, Washington is just discovering, a system of quotas rather than a system of new tariffs. Probably the only reason that Assistant Secretary Grady and his staff are not asking Congress for radical trade bargaining authority is that they know Congress would not grant it.

Silver Controversy

LINES OF BATTLE over silver policy are again being drawn in Washington. The occasion is the real pressure being put behind Senator Townsend's bill to repeal the authority of the Treasury to buy foreign silver under the present program. As in most other economic legislation of international significance, domestic politics determines alliances.

Perhaps most embarrassed of all those involved in this battle is Secretary of Treasury Henry Morgenthau, Jr. He finds himself on both sides of the fence. He is not even permitted to straddle because of the political meaning of any Treasury policy he may advocate. His dual personality is caused by two independent and conflicting desires.

1. The purchase of more foreign silver is a questionable fiscal policy. A conservative Secretary, therefore, is constrained by both head and heart to refrain from acquiring the white metal. According to conservative economists, it would do no harm to most American business and therefore not interfere with corporation tax collection. As Treasury watch dog there is no divided allegiance. But—

2. The Administration wants every possible leverage available to it when international negotiations are under consideration. As a loyal supporter of the President and of Secretary Hull's trade agreement program, Secretary Morgenthau knows that the ability to buy silver at a price fixed by the Treasury is a great talking point in many negotiations, especially with Mexico. Hence, the Secretary would like to be able to pull a strong oar of silver buying authority. Loyalty to the Administration program has outweighed the fiscal officer judgment and hopes, and Secretary Morgenthau is on record as opposing any repeal of this authority.

Another angle on the situation is the gold buying policy of the Administration. If silver buying were stopped, there would immediately be demand that gold buying cease also. The Administration —and Congress—want the Allies to win the war. To stop gold buying would handicap the Allies greatly.

The Townsend bill limiting silver-buying could be forced through the Senate, as was the Hatch clean-politics bill, but tremendous logrolling would be required in the House to pass the measure.

Strategic Commitments

THE $10,000,000 appropriated for the fiscal year 1940 has been expended. For 1941 both Senate and House agreed on $12,500,000, but the Senate wanted $5,000,000 to be immediately available. The bill, after going to conference, was reported out with a compromise of $3,000,000 immediately available. Both Senate and House must approve this conference report before the bill goes to the President. The original authorization is for $100,000,000 to be expended by June 30, 1943.

Present contracts may be summarized as follows:

Article	Quantity	Value	Source
Quinine	700,000 oz.	$404,600	Netherlands East Indies
Tin	4,120 short tons	3,915,088	Netherlands East Indies
Quartz crystals	14,800 lb.	98,875	Brazil
Chromium ore	45,000 long tons	1,373,600	Alaska and Turkey
Manganese ore	76,000 long tons	2,258,568	Cuba, Canada, Philippines, Brazil, S. Africa, India, and U. S.
Tungsten ore	425 short tons	427,140	China
Manila fiber	6,800 bales	118,582	Philippines
Optical glass	11,400 lb.	75,200	To be produced by Bureau of Standards
		$8,671,653	

The total value of these materials adds to only slightly over eight and a half millions. The balance of $1,328,347 is necessarily being held in reserve until late in the year to cover duty payment which must be charged against this account, freight charges for moving these materials around in this country, overage on actual delivery, and other minor items.

One Senate enthusiast for the strategics stockpile—Senator Townsend, of Delaware—has gone so far as to propose use of $500,000,000 of the gold profits for the purchase of additional strategic materials. It is highly improbable that the proposal will be adopted, for two reasons. First, Uncle Sam could hardly spend that much effectively in the present chaotic world markets. Second, neither the President nor Congress is going to let go all those gold profits when budget problems are so serious in the immediate pre-election period. It is highly improbable that the spending between now and July 1, 1941, will exceed the sums already appropriated or about to be made available.

Cooperative or Forced Probes?

MR. ICKES continues to seek authority to pry into mining affairs as and when he wishes. The Ickes-Bureau of Mines controversy continued during March with new evidence that the Secretary did not wish to limit mine safety inspections to those voluntarily accepted by the industry. This is one of the five important points at issue described in these columns in the very first interpretation of the forced resignation of Dr. Finch. (See *E.&M.J.*, January, page 70.)

Although relating directly only to coal mine safety questions, the present issue has as great importance for metal miners and producers of non-metallics. The real issue is whether Federal inspectors may be sent into a mining property for snooping desired either by C.I.O. or by some zealous government agent, irrespective of the management's judgment or rights. If Mr. Ickes has his way the long-established system of cooperation through voluntary inspection will be set aside. The question of states' rights will then be blandly disregarded.

The Bartley, W. Va., coal mine disaster brought this matter into the spotlight. In that case the usual Federal rescue service was supplemented by the Bureau engineers' study of possible or probable causes. The Bureau made its findings available to the company for its assistance, but refused further release. United Mine Workers officials demanded access to the report, and this was granted after Secretary Ickes was informed by the Solicitor of the Department of Interior that the Department

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had authority to make such reports public. The Secretary declared that it was in the public interest to do so. The Bartley report is now available for public inspection on file in the Bureau of Mines.

The American Mining Congress took exception to this breaking of long-established practice by the Secretary. Mr. Ickes replied with customary vim, branding the American Mining Congress as "a lobby seeking to conceal the facts on mine accidents." One thing is certain: Proponents of the Federal mine inspection bills are going to play up the two great mine disasters of recent weeks, that at the Bartley mine and the more recent one at the St. Clairsville, Ohio, Willow Grove mine.

Manganese Awards

ON MARCH 18 the Procurement Division of the Treasury Department made the final manganese purchases expected from the current fiscal year's appropriation. L. W. Lambert, Upper Lake County, Calif., was awarded a contract to supply manganese ore under Schedule S-18, opened March 6, as follows: Grade B (Philippines), 5,000 tons 65c. l.t.u. (cents per long ton unit of contained manganese), $156,000.

An additional award was also announced on March 18 as being made in lieu of a defaulted bid in an earlier award. This was the Greenbrier Mining Company bid (See *E.&M.J.*, November, 1939, page 27). The new award, announced as "purchased against contractor's account," was to Lucien L. Patrick, Los Angeles, Calif. Grade A (domestic), 5,000 tons 62c. l.t.u., $148,000.

News "Fines"

Taxing Machines—Probably with his tongue in his cheek, Senator O'Mahoney introduced a bill during March which would provide for a heavy new Federal tax on labor-saving machinery. This is the orthodox conclusion of that school of economists which argues that all machinery destroys jobs. Washington does not expect TNEC officially to back this radical proposal, but it shows how far back toward the horse-and-buggy days some folks are looking in their effort to find reemployment. Nothing is too strange for Washington in this search.

TNEC Continues—It is now definitely planned that TNEC will make its major report to Congress next December. Thus the results of its long economic study would be available at the opening of the next Congress. But they will remain confidential until after election day, a thing politically expedient for those who wish some of the recommendations to be rather drastic.

WPA "Rock Drilling" Booklet—Studying rock drilling technics, the WPA group has made an extended statistical analysis from which it draws some rather interesting conclusions. For example: "Strength and endurance are no longer so important to the driller as quick reaction time and training in the use of mechanical devices" and "Long-time forces will make for an increase in the number of men employed in drilling at mines." The full report of this study as to the technologic factors determining the extent of employment in mining is titled "Mineral Technology and Output Per Man Studies—Rock Drilling," National Research Project Report No. E-11, by C. E. Nighman and O. E. Kiessling. It was made by the National Research Project in cooperation with the Bureau of Mines. Those interested should request this document from Works Progress Administration, 1734 New York Avenue, N. W., Washington, D. C.

Tin Placer Mining—Application filed by the American Mining Congress for the exemption of open-cut or surface mining of tin in Alaska from the maximum provision of the Fair Labor Standards Act of 1938, because it is a branch of an industry of a seasonal nature, was approved by the Department of Labor on March 18.

MINING CONGRESS TO MEET IN COLORADO SPRINGS

SELECTION of Colorado Springs as site for the Seventh Annual Metal Mining Convention and Exposition of the American Mining Congress has been announced by Julian D. Conover, Secretary of the organization. The meeting will be held Sept. 16–19 at the Broadmoor Hotel.

MERRILL E. SHOUP, president of The Golden Cycle Corporation, has been elected chairman of the Board of Governors of the Mining Congress' Western Division, under whose auspices these annual conventions and expositions are held. Appointment of committees to draft plans for the meeting will be made shortly.

Mining Loans Approved

THE following is a list of mining loans approved by the Reconstruction Finance Corporation from the period Sept. 1, 1930, through February 29, 1940.

Location (County)	Applicant	Amount Approved
	Arizona	
Yavapai	Steve Loncar Wickenburg, Arizona	(a) $15,000
	California	
Shasta	French Gulch Dredging Company 1367 Russ Building San Francisco, California	160,000
Butte	Oroville Gold Dredging Company 2052 Bird Street Oroville, California	(a) 180,000
	Colorado	
Park	South Platte Dredging Company 1805 Mills Tower San Francisco, California	750,000
	Washington	
Okanogan	Arlington Mines, Inc. Commercial Bank Building Okanogan, Washington	20,000

(a) Note — Including loans previously authorized

Total amount of mining loans authorized	$14,923,100.00
Total amount of mining loans cancelled	7,472,000.00
Total amount of mining loans disbursed	5,330,438.60
Total amount of mining loan repayments and other deductions	2,416,087.55

Research Fellowships

THE University of Maryland in cooperation with the Bureau of Mines, offers three fellowships for research in the field of engineering and applied science. Payments are made at the end of each month and amount to $600 for the year. Applications with a certified copy of college record, applicant's photograph, statement of technical and practical experience (if any), and letters from three persons, such as instructors or employers, will be received up to May 1, 1940. Address the Fellowship Committee, Eastern Experiment Station, Bureau of Mines, United States Department of the Interior, College Park, Md.

1939 Lake Superior Iron Ore Shipments

Mine shipments of Lake Superior iron ore from the various ranges, for 1939 as reported by the Lake Superior Iron Ore Association and the tonnage of beneficiated ores are given in the following table:

Summary In Long Tons

Range	To Upper Lake Ports	All-Rail	Total
Mesaba	29,982,408	332,449	30,314,857
Vermilion	1,400,134	17,226	1,417,360
Cuyuna	1,286,904	3,769	1,290,673
Gogebic	5,341,939	3,619	5,345,558
Marquette	4,832,184	75,439	4,907,623
Menominee	2,157,088	3,508	2,160,596
Total — (U. S. Ranges)	45,000,657	426,010	45,436,667
Michipicoten (Canada)	71,958	39,349	111,307
Grand Total	45,072,615	475,359	45,547,974

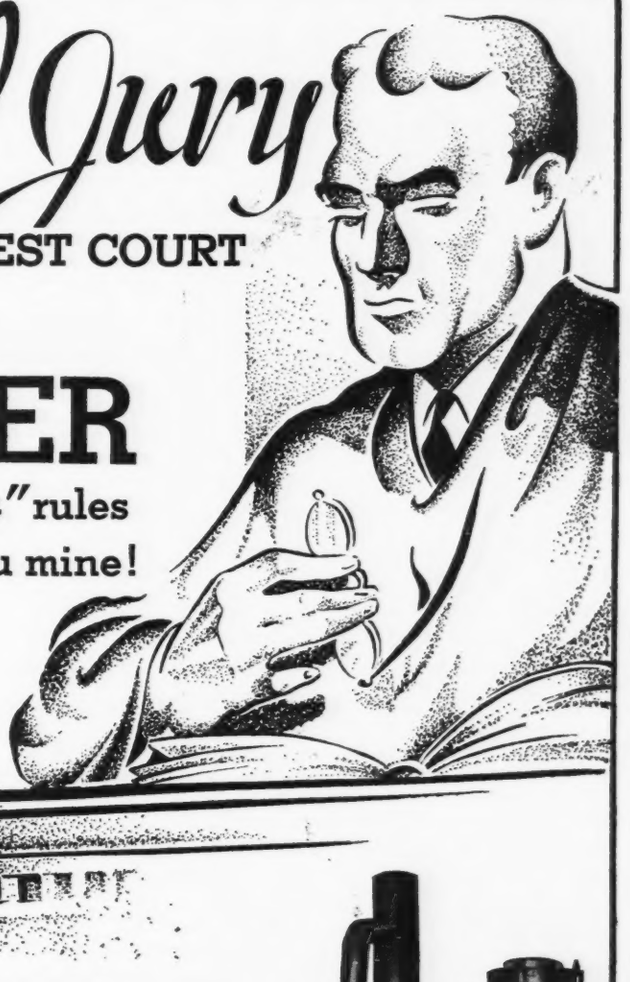
Beneficiated Lake Superior Ore, Year 1939, in Long Tons

Product	Minnesota	Michigan & Wisconsin	Canada	Total
Washed	4,600,077	.....	.....	4,600,077
Jigged	969,518	.....	.....	969,518
Hi-Density	177,835 (a)	.....	.....	177,835 (a)
Sintered	254,224	.....	.....	254,224
Dried	219,709	.....	.....	219,709
Total concentrates	6,221,363	.....	.....	6,221,363
Crushed and/or screened	9,843,244	3,696,507	.....	13,539,751
Total beneficiated — (U. S. ranges)	16,064,607	3,696,507	.....	19,761,114
Sintered (Canadian)	.....	.....	111,307	111,307
Total beneficiated	16,064,607	3,696,507	111,307	19,872,421

(a) Includes 11,019 tons of cone tailings shipped as siliceous ore.

Judge and Jury

OVER MINING'S HIGHEST COURT



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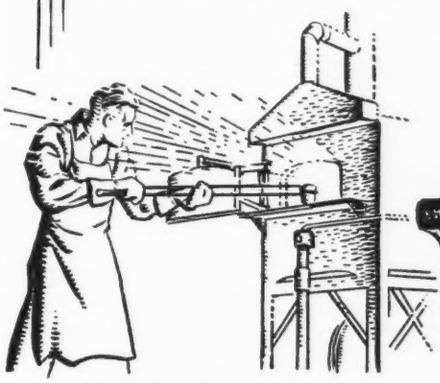

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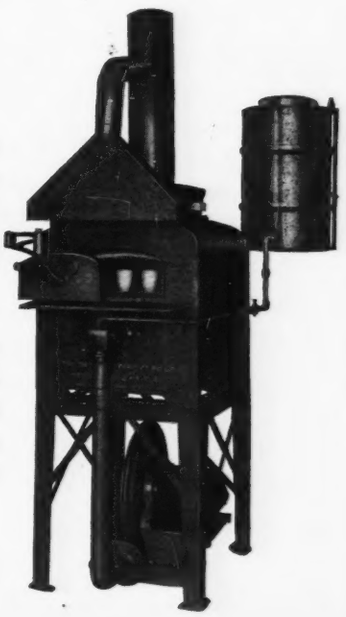

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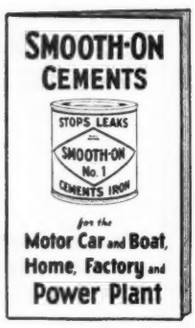

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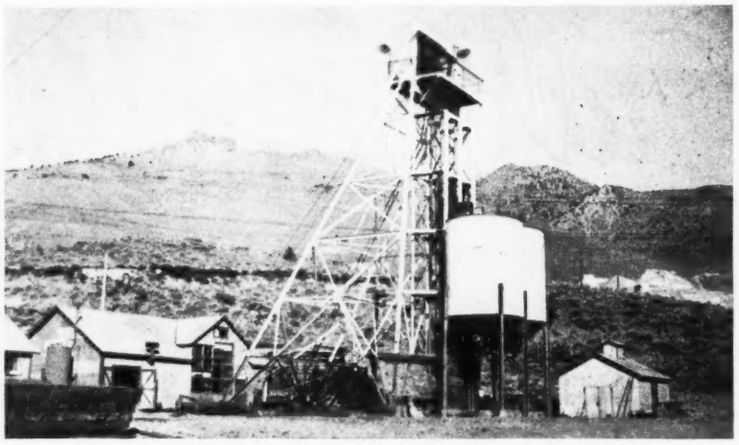

Surface plant of the Consolidated Chollar, Gould & Savage property on the Comstock Lode at Gold Hill, Nevada. The company recently completed construction of a new crushing plant

NEVADA

Manganese and Mercury Deposits Being Developed

Preliminary work under way on manganese claim in Pumpernickel Valley district—Quicksilver properties in Humbolt and Mineral Counties active—Testing on large gold placer nears completion

▶ Manganese deposits in the Pumpernickel Valley district, in Pershing County, including the Black Diablo mine, have been taken under lease and option by men from Provo, Utah, who are preparing to ship the ore to a plant at Provo. The O'Leary-Hicks property was leased to R. H. Richards and Hollis E. Chatwin, of Provo and Salt Lake City, and the Black Diablo or Clough group to B. D. Palfreyman, of Provo, who was said to have filed with the Treasury Department a bid for delivery of manganese ore. Equipment, including compressors and bulldozer for surface stripping, has been provided.

▶ Cinnabar claims known as the Cordero group, situated near McDermitt, in northern Humboldt County, have been taken under option jointly by the Horse Heaven Mines, Inc., of Portland, Ore., and the Sun Oil Company, of Philadelphia. Mine equipment and a diesel power unit were said to have been ordered. E. E. Gardanier, said to be field engineer for the optionees, secured the option for J. Edgar Pew, head of both participating companies, and Samuel H. Williston, vice-president and geologist for the Sun Oil Company.

▶ Discovery of a body of rich cinnabar in workings of the Mina Mercury Company in the Pilot range, Mineral County, has been followed by increased furnace production of mercury, lessees of the property having shipped 25 flasks in one recent week. The property, idle for many years, has been under lease for some time to A. J. Anderson, of California, and work, resumed within the past three months, is directed by L. B. Spencer, engineer, of Mina.

▶ Test work conducted by the Natomas Company in recent months is nearing completion on a broad alluvial fan below the mouth of Copper Canyon, in Lander County. The claims are under option to a group composed of heads of the Natomas Company and San Francisco business men. Selection of dredging equipment will be made shortly. W. G. Donaldson, associated formerly with Engineer Greenan in the Philippines, has been in charge for the Greenan Placers, Inc. Richard Smith is directing work for the Natomas Company as superintendent and Col. W. H. Lanagan is consulting engineer for that company.

▶ Several patented claims on the Brunswick lode, in the Comstock district, including some early-day producers of note, have been acquired under option by N. H. Getchell, vice-president of the Getchell Mine, Inc., who was reported also to have purchased outright the Trimble custom mill, at Silver City, a 35-ton plant employing flotation and table concentration.

▶ Early construction of a 50-ton flotation mill is planned by heads of the Mountain City Development Company, lately formed by Pocatello, Idaho, men to operate the Telephone sold-silver mine at Merritt Mountain, 6 miles northeast of Mountain City, Nev. The property, bought from W. C. Schiffman, of Mountain City, is near that of the Afterthought Mines Corporation, formed last year as a subsidiary of Mountain City Copper Company, with J. J. Lillie, manager. F. L. Randall, of Mountain City, is superintendent for Mountain City Development Company.

▶ At the Nevada Consolidated Copper Corporation's property, a subsidiary of Kennecott Copper Corporation, E. T. Stannard, president, said the stripping program on the south and southwest sides of Liberty Pit was actively prosecuted; the Star Pointer shaft was sunk 180 ft. preparatory to mining that part of the Ruth orebody which lies below the ninth and is tributary to the eleventh extraction level. A limited tonnage of ore was mined, the output being slightly higher in the second half of the year than in the first. Due, however, to receipt of increased ore tonnages from

Consolidated Coppermines Corporation for treatment under the contract between the two companies, the reduction plant was operated at approximately three-fourths capacity. The only capital expenditure incurred was in connection with the installation of a dust-collecting system in the sampling mill at McGill.

▶ Lessees working on the 1,200-ft. level of the White Caps mine, at Manhattan, Nye County, are said to have opened a 15-ft. width of gold ore that sampled around $40 per ton. Homer L. Williams is manager.

SOUTH DAKOTA

Yates Shaft Expected to Be Ready This Summer

Annual Report of Homstake Mining Company shows that more than one million tons of ore were treated—New vein under development

▶ Guy N. Bjorge, general manager of Homstake Mining Company, in the annual report of the company stated that operations during 1939 were normal in all departments. Production was 1.62 per cent higher than in 1938 and the gross income for gold and silver produced was 3.31 per cent higher. It is expected that production for 1940 will be slightly lower than in the past year. Operating expenses exclusive of taxes were slightly higher in 1939 than in 1938. Total taxes were $3,132,512.11, which is slightly higher than in 1938. This amounted to $2.24 per ton of ore mined. The reserve of developed ore is 18,395,991 tons. Of this reserve 7,653,400 tons are in the new ledge which has been under development for the past three years. This ore is materially lower in grade than that in the main ledges. Production from this ledge began in 1939 and will be substantially increased in 1940. It is expected, therefore, that the grade of ore produced in 1940 will be slightly lower than that for 1939. All changes resulting from reconstruction of cyanide sand plant No. 1 are completed. Improvements in the metallurgical plants which began with the construction of cyanide sand plant No. 3 in 1933 have resulted in material economies in treatment cost. Yates shaft construction has made excellent progress. In the shaft, 3,426 ft. of pilot raises are completed, of which 1,714.5 ft. have been stripped to full size and timbered. The hoist building, headframe, and crusher house are nearly completed and installation of equipment is under way. It is expected that the shaft will be ready for operation soon after the middle of the year. The winze from the 4,100-ft. level was sunk to the 4,550-ft. level and 543 ft. of level development was completed on the 4,550-ft. level. Precipitation was again below normal and power output from the hydroelectric plants was the lowest on record. Bullion produced during 1939 was reported to be valued $19,922,964.60. During the year 1,400,015 tons of ore were milled, realizing an average of $14.23 per ton.

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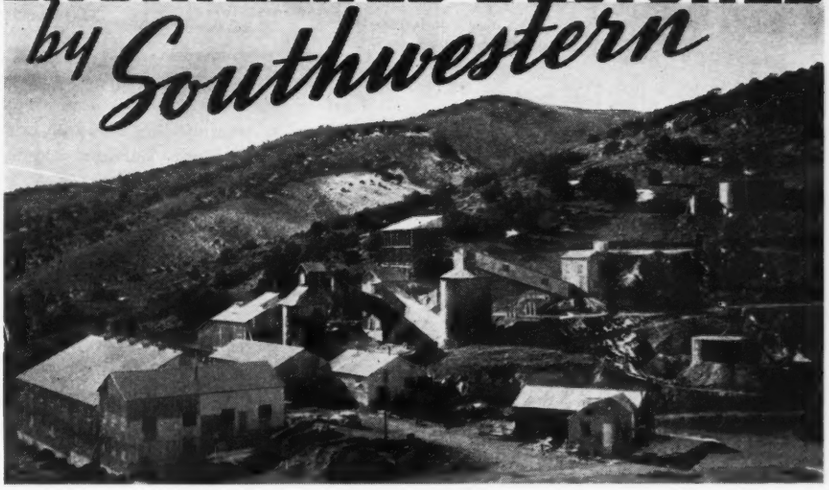

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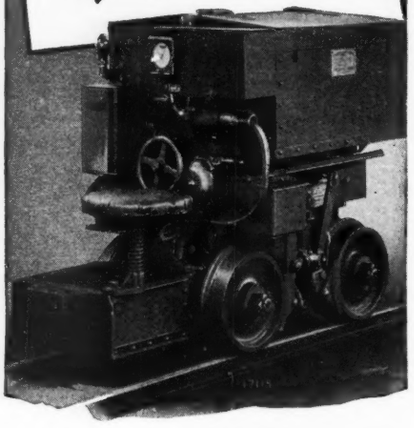

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UTAH

South American Mines Ship to Midvale Smelter

European war diverts some silver-lead-antimony concentrates to this country that formerly went to Germany—Utah Copper Company to centralize all research activities at Arthur—Tintic Standard planning erection of concentrator

▶ Eighteen hundred tons of silver-lead-antimony concentrate has arrived at the Midvale plant of the United States Smelting Refining & Mining Company from Chile via Los Angeles. This shipment, the first of its kind to reach Utah, came via the Pacific on the Norwegian motor-ship, "Indra." Ordinarily such consignments are shipped to Germany. The shipment, according to F. S. Mulock, vice-president and general manager of western operations for the U. S. Smelting, Refining & Mining Company, to be followed by others is the product of several mines in Chile, Peru, and Bolivia. Mauricio Hochschild & Company were the shippers.

▶ In the annual report of Kennecott Copper Corporation, E. T. Stannard, president, stated that a total of 27,558,108 tons of ore having a calculated average assay of 1.02 per cent copper was treated at the four domestic properties of the Corporation. Copper output amounted to 502,570,103 lb., or about 50 per cent more than the 1938 production of 334,816,884 lb. In addition to the ore mined, approximately 36,573,000 tons of non-commercial overburden were removed at the power-shovel properties in Utah, Nevada, and New Mexico, this tonnage being equivalent to 1.40 tons overburden per ton of ore sent to the respective concentrating mills. At the Utah property the area now covered by mining and stripping operations totals about 648 acres. Copper production varied from an average of around 23,000,000 lb. per month from January to August, inclusive, to a high of almost 40,000,000 lb. in November and December. Recoveries at the concentrating plants were maintained at practically normal levels when handling the heavier tonnages. Miscellaneous additions and improvements were made at the mine and mills, with dust control facilities and shops for repairing cars and locomotives receiving particular attention. Ten brick and stucco houses were erected at the Copperton townsite to provide additional housing facilities for employees, making a total of 164 houses at this location. A new administration building was completed at the Arthur plant, and the old building is now being remodeled into an up-to-date laboratory, which, when completed, will make possible the centralization of all research, assay, and chemical work. Several wells drilled within the past two years to insure a reserve water supply for concentrating purposes in the event of extreme drought conditions were equipped with pumps and made ready for service.

Molybdenite production from the mines of Kennecott Copper Corporation in 1939 amounted to 12,055,554 lb., including 111,561 lb. produced in an experimental way at the Braden plant, in Chile. The molybdenite content of the ore treated at the Utah and New Mexico properties averaged 0.0354 per cent and the recovery was 71.31 per cent. In contrast, the 1938 recovery was 60.08 per cent and in 1937, the first full year of operation, 43.41 per cent. The demand for molybdenite was seriously curtailed on the outbreak of war and largely as a result thereof the entire production was not sold. Since December the market has been narrowed even more and there has been a further accumulation of unsold product.

▶ During the year 1939 the average grade of ores mined at the property of the Tintic Standard Mining Company, was lower than in the previous year, according to the annual report submitted by James W. Wade, president. As greater depth is reached, the ore bodies are more homogeneous, and selective mining is less effective in separating the ore into classes for shipment to the smelters. Such necessary selection can be made more economically by a mill. During the year, metallurgical tests were conducted on the ores, and plans and estimates of the cost of construction of a milling plant are now being considered. Development work disclosed ore bodies distinctly different from those previously mined. The ores developed on the 1,450-ft. level in the quartzite lying below the ores previously mined are predominantly gold, silver, and copper.

▶ The Mayflower Tunnel has been advanced to beyond the 7,000-ft. mark in the New Park Mines property at Park City, reports W. H. H. Cranmer, president and general manager. Production has been stepped up from 500 tons to 1,100 tons a week. Gross value of the ore is $17.85 and a net of about $14.00 a ton after smelter charges.

COLORADO

Vanadium Corporation to Increase Production

Mining operations scheduled for two-shift basis—Idarado Mining Company planning development in San Juan district

▶ The Vanadium Corporation of America will start working two shifts of miners on the Fall Creek mine, at Vanadium, as soon as weather conditions permit. Bery Hughes, representative of the Vanadium Corporation, states this will probably be around May 1.

▶ Work on the property of Moraine Mining Company in Leadville has been discontinued due to unfavorable development, but Resurrection Mining Company, owned jointly by Hecla Mining Company and the Newmont Mining Corporation, continued development throughout the year. Due in part to limited success in development, and in part to the high prices at which idle properties are still held in this almost deserted camp, erection of the reduction plant programmed for the summer of 1939

has been held up, but may be carried out during the summer of 1940, according to the annual report of the Newmont Mining Corporation. During the year the corporation joined Sunshine Mining Company and others in the consolidation of, and subsequent provision of capital for, development of a large area in the San Juan district of Colorado. Some low-grade ore is known to exist in the property and a leisurely development program will be initiated in 1940 to prospect other veins made accessible by extension of a haulage tunnel into hitherto undeveloped areas. Newmont has had a financial interest in this area for some years. The consolidation has initiated development under caption of Idarado Mining Company.

▶ Climax Molybdenum Company, according to the report of Max Schott, president, produced slightly less than 22,000,000 lb. of molybdenum contained in concentrates in 1939, compared with approximately 28,000,000 lb. during the year 1938. This lower production during 1939 was the result of curtailment of operations from April through September, due to uncertainty of market conditions and the fact that the company had an inventory sufficient to meet any unforseen increase in demand. Unusually large commitments for deliveries during the last quarter of the year made it advisable to raise operations starting in October to the rate of production maintained during 1938. Stockholders were advised on Dec. 28, 1939, of the cessation of sales of molybdenum to certain countries. The company's total sales for the year 1939 were approximately 26,800,000 lb. of molybdenum. Sales during the first two months of 1940 were about 3,100,000 lb.

▶ Climaxing the Engineers' Day program at the Colorado School of Mines, March 15, was the dedication of the recently completed Geology-Geophysics Building. The featured speaker of the day, Dr. Everette L. DeGolyer, eminent geologist and geophysicist of Dallas, Tex., gave the dedicatory address, in which he surveyed the development of the two sciences, geology and geophysics, and discussed particularly their application to the present. The new building has been named Berthoud Hall, honoring Captain Edward L. Berthoud, first professor of geology at the Colorado School of Mines and a man prominent in the economic, scientific, and political development of Colorado. The structure has three main floors, an upper fourth floor for storage, and a basement, and is completely air-conditioned and modern in every respect. Housed in the museum will be the School of Mines collection of minerals and fossils, included in which is the collection of crinoids recently donated by Mrs. John T. Barnett, of Denver. The series of mining murals which were painted by Irwin D. Hoffman for Treasure Mountain at the Golden Gate International Exposition and which were procured for the School of Mines by Mr. and Mrs. Barney Lee Whatley, of Denver, also will be displayed in the museum.

▶ The new Carlton drainage tunnel being driven by the Golden Cycle Corporation was driven 1,158-ft. in February, an average of 52.34 ft. per day. On March 19 the face of the tunnel was in 11,210 ft.

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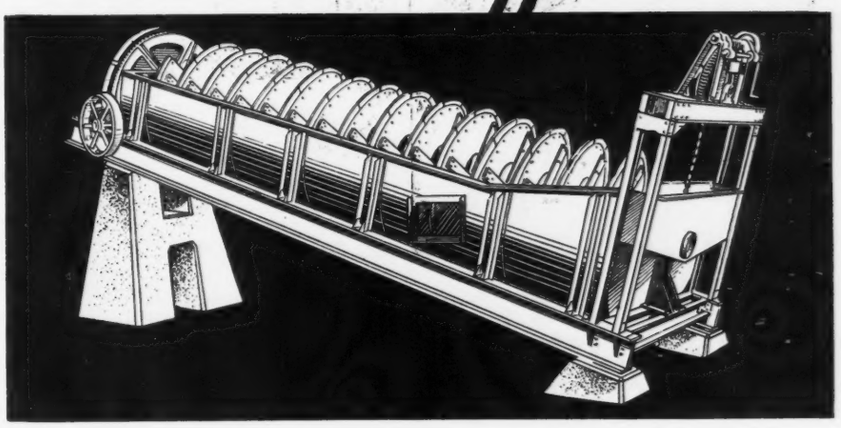

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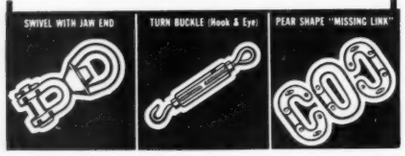

The new half-million-dollar unit to the Bunker Hill smelter at Kellogg designed to treat the tetrahedrite ores of the Coeur d'Alene silver belt. The recently perfected Lee-Muir process used in the plant is expected to produce a purer antimony oxide than has ever before been possible and at the same time produce a high-grade electrolytic antimony. An initial test run was made on March 1. The antimony plant started operations on March 25.

IDAHO

Helca Mining Company Will Sink Shaft

Work on the recently acquired Atlas property to start soon—Development of You Like vein of Federal Mining & Smelting Company shows good ore

▶ Hecla Mining Company is moving equipment to the Atlas mine, at Mullan, to begin the sinking of a new 800-ft. development shaft. The collar of the shaft will be 9,000 ft. from the portal of the main Atlas tunnel. Ralph W. Neyman, of Osburn, will be in charge of the work under supervision of L. E. Hanley, president and general manager of Hecla, which recently closed a deal for the purchase of the controlling interest in the Atlas property.

▶ Federal Mining & Smelting Company's annual report showed net income of $1,013,317.20 for 1939, compared with $549,994.96 for 1938. Tonnage production at the Morning mine amounted to 363,122 tons, an increase of 100,793 tons over the 1938 output. Average grade of ore mined was 7.6 per cent lead, 2.9 oz. silver, and 5.7 per cent zinc per ton. Concentrates averaged 77.6 per cent lead and 54.2 per cent zinc. Ore reserves are estimated at 960,000 tons of developed ore, an increase of 110,000 tons over 1938 estimated tonnage. The finding of additional ore in the You Like vein was an important development of the year. Mining on the You Like vein was discontinued 20 years ago, but recent operations disclosed important orebodies. A crosscut to the vein was run from the 2,450-ft. level of the Morning. On the 1,000-ft. level of the You Like vein the average of an orebody 280 ft. long and 4.6 ft. wide was 18.2 oz. silver, 3.5 per cent lead, and 2 per cent zinc. Ore reserves at the Federal's Page mine, near Kellogg, are estimated at 405,000 tons. An enlargement of the Page mill was completed and it is now treating 400 tons of ore daily.

▶ Center Star mine, at Elk City, is treating 15 tons of gold-silver ore daily in a small amalgamation and flotation plant. Eighteen men are employed.

▶ Porter Bros., Helena, Mont., gold dredge operators, have secured a lease and bond on 2,800 acres of patented ground along Prichard Creek, in the Murray district, from the Coeur d'Alene Mining Company. All of Prichard Creek above this area was dredged by the Yukon Gold Company years ago.

▶ General Electric Company is making active preparations to develop its group of 24 tungsten claims in the Blue Wing mining district of Lemhi County. Several cars of tungsten ore were recently shipped to Cleveland.

▶ Aurora Mining Company, in the Murray district, has opened an 8-ft. vein of lead-silver ore. A new electric power line will be built to the property and electric motors will replace present gas equipment.

▶ The Princess-Blue mine, near Fairfield, is being reopened by J. G. Jones, of Fairfield, who is leasing the property from the Consolidated Mines Syndicate. Jones will install a small milling plant to treat dump ores in addition to newly mined ore.

▶ Idaho Consolidated Gold Mines, operating the old Golden Chest mine and Mother Lode mill, in the Murray district, report running mill feed that will average one-half ounce of gold per ton. Concentrates carry about 25 oz. per ton and are being trucked to the Bunker Hill smelter at Kellogg. E. B. Gibbs, of Spokane, is manager.

▶ Crown Consolidated, Inc., will operate the old Silver King mine, in the Sawtooth district north of Sun Valley. The property is now being unwatered, with work in charge of George B. Guillotte, a Salt Lake mining engineer. B. C. Rich, of Salt Lake, is president.

▶ Consolidated Rapid River Company reports the discovery of cobalt ore, which is being developed by a deep crosscut tunnel in the Rapid River district.

▶ Mild winter and early spring have speeded up mining operations in the Elk

City district. Dredging operations are being resumed at the Mount Vernon placer property. Seattle interests are moving a dredge up Little Elk Creek and another is being taken to the Noon placer.

▶ Condor Gold Mining Company's property near Salmon will resume operations as soon as there is sufficient water to operate the hydroelectric plant, according to J. T. Hammond, Jr., of Salt Lake, vice-president. The mine is closed every year because of severe winter conditions.

▶ Old and new mines in Custer county are showing more activity than in many years, according to Arthur Campbell, state mine inspector. Elk Creek Mine, Inc., has a 6-ft. orebody showing high value in its property near Stanley. E. V. Howard of Stanley, is president.

MONTANA

Placer Area in Park County to Be Tested

Preliminary prospecting warrants program of thorough drilling—General Mines Company plans greater mill capacity

▶ A placer area involving 1,500 acres in Park County was recently examined by engineers of the Lucky Tiger-Combination Gold Mining Company. Four holes were drilled to 100 ft., and results were sufficiently encouraging to justify obtaining an option on the property for a thorough drilling campaign. Should results prove satisfactory, the company is reported planning the installation of a dredge. The property, known as the Emigrant placer, is about 30 miles from a high-tension electric power line near a main highway and approximately four miles from a railroad station. A. E. Mosier is president of the company, with offices at 710 Commerce Building, Kansas City, Mo.

▶ James Reed, of Nespelem, Wash., who is associated with J. C. Roberts in the operation of the High Ridge gold mine, near Twin Bridges, has according to reports from Virginia City, acquired the Easton Pacific mine, four miles south of that city. This property was an important gold and silver producer many years ago under the Elling ownership. More recently, several attempts have been made to revive the property. The last group, known as the Pacific Gold Mining Company, completed installation of a 75-ton flotation plant, which is now involved in the Reed purchase. Lessees are extracting shipping ore from the upper levels, and, an active program on milling ore is expected to start soon.

▶ Ross L. Roundy, of Wallace, Idaho, who a short time ago acquired the Lee Mountain lead zinc properties, in the Rimini district, is reported to have added the Little Lily mine of the General Mines Company to his holdings in the area. It is further reported that plans are being considered to enlarge the 30-ton General Mines Company mill to a capacity of 100 tons a day. F. E. Scott, of Wallace, is president of the General Mines, Inc.

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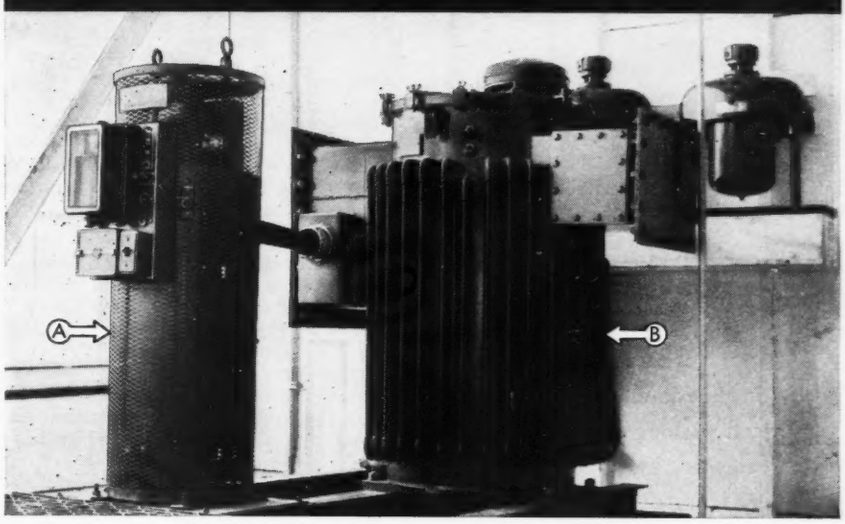

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WASHINGTON

Working Shaft Projected At Chelan Copper Mine

Property owned by Howe Sound Company will be further developed by shaft below haulage level—Zinc producers hope for change in tariff act

▶ According to the annual report of the Howe Sound Company, operations at the Chelan Division in 1939 were at capacity of the milling plant, which is approximately 2,000 tons per day. From July 7 to Aug. 20, however, a strike forced a suspension of operations. An intensive program of exploration and diamond drilling was prosecuted throughout the year. This work will be continued during the current year, and development will be augmented by the sinking of a working shaft about 1,100 ft. below the main 1,500-ft.-haulage level. C. P. Browning is general manager and George C. Lipsey is general superintendent.

▶ Pend Oreille Mines & Metals Company, at Metaline Falls, closed its mine and mill for a few days early in March, in order to repair its big crusher. About 25 men were employed in the repair work. Any announcement that the Grandview mill, also at Metaline, is to be put into operation by American Zinc, Lead & Smelting Company, which has it under lease for the treatment of ores from the Grandview and Metaline Mining & Leasing Company will depend on the future of the domestic zinc market and the continued depressing effect of the Trade Agreements Act on zinc mining. The reduced tariff on zinc now in effect has prevented operations at this property because of low metal prices.

▶ Kaaba Texas Mining Company expects to install a 200-ton flotation mill at its property at Nighthawk, near the northern boundary of the State. A new hoist and compressor also will be added to facilitate the extension of a 1,000-ft. drift, on the 425-ft. shaft level.

▶ Aurum Mining Company is reported curtailing operations in the Republic camp, in northern Washington, because of higher costs in mining its low-grade gold deposit.

▶ Lee Thorpe is chairman of a special committee of stockholders of Queen Seal Mining Company, which is planning resumption of operations at the property, 60 miles west of Spokane, in the old Deer Trail silver district.

▶ Western Molybdenum Corporation, at a recent stockholders' meeting in Spokane, elected Herbert S. Swanson, president; J. J. Scherr, vice-president, and the following additional directors: Henry C. Swan, John Bamford, Fred Crow, F. R. Green and B. M. Allen. The company is developing the old Juno-Echo mine, near Chewelah, which was worked years ago for its copper-silver values.

▶ A 4-ft. vein of galena was reported struck in March by Merle Carr and brothers at the Wells Fargo mine, 13 miles west of Valley. The property, one of the older mines in Stevens County, has been leased by the Carrs for eleven years. Shipments were to begin as soon as roads are in better condition.

▶ H. H. Harris and associates, of Naches, have leased the gold claims on Fidalgo Island, near Anacortes, from Lester E. Gibbons, who leases the ground from the city of Anacortes. A mill will be erected if exploration proves satisfactory.

▶ Thomas B. Hill, supervisor of the Department of Conservation and Development in the State of Washington, has made a report on the strategic metals of the State. A line drawn east and west through the State, one third of the distance from the north boundary, places many tungsten deposits in several counties north of that line. The Germania mine, in southern Stevens County, now owned by General Electric Company, has been the chief producer. He also mentions Tungsten Producers, Inc., Loon Lake Tungsten Company, Columbia Tungsten Company, and Industrial Tungsten Corporation as other producers in Stevens County. James Keith, of Spokane, unincorporated, is an intermittent shipper. The Bumping Lake District of Yakima County is credited with substantial tungsten deposits. Others he mentions are Red Top mine, near Northport; Pacific Mutual Silver-Lead mine, near Keller, and Stockwell mine, in Ferry County. He calls attention to the Antimony Queen mine, in the Methow district; the Longstreet mine, which has antimony associated with silver, and the R. E. Lee mine, in that county, also an antimony deposit. Chromite is found in Chelan, Kittitas, and Okanogan counties.

ALASKA

More Large Dredges to Exploit Gold Placers

United States Smelting Refining and Mining Company plans new unit this year and another in 1941—Callahan Zinc-Lead Company plans production with new dredge at Livengood area next year

▶ At Fairbanks, dredging operations of the United States Smelting, Refining & Mining Company started for the season on March 15, 1939, and continued until about the first of December, according to the annual report of N. W. Rice, president. The six dredges aggregated 1,462 dredging days, compared with 1,453 in 1938, and handled a slightly greater yardage of gravel of approximately the same grade. On the new area mentioned in previous reports the installation of the dragline and conveyor was completed and the removal of the upper barren gravels commenced during the latter part of the season. A new dredge is being erected and should be ready to start work on the underlying pay gravels in this area about the middle of the 1940 season. Another newly acquired small dredge will start work on an outlying area during 1940.

▶ At Nome, dredge No. 2 started on May 28, 1939, and all three dredges were in operation by June 17, continuing until about the middle of November, an aggregate of 483 dredging days compared

with 468 in 1938. Yardage dredged was a little less than in 1938, but value per yard slightly more, the net result being a small increase in the amount of gold recovered. Plans for the installation of a fourth, deep-digging dredge are completed, and this dredge will be ordered in 1940 for operation in 1941. At both the Fairbanks and Nome fields preparation of ground has been actively carried on, with the result that at present there is a greater yardage of thawed ground ahead of the dredges than in any previous year. Acquisition and development of additional dredging ground has been going on steadily, and the known gold reserves at the end of 1939 are greater than at any time in the past.

▶ Steady progress was made during the winter on the water tunnel, 3,200 ft. long, which Livengood Placers, Inc., has been driving at its property near Fairbanks. This will take water from one creek into another. The company also has been taking in equipment and supplies and has a road in good condition most of the distance to the property. The company is a subsidiary of the Callahan Zinc-Lead Company, of New York City. Production is expected to begin in 1941, as the first gold dredge costing about $300,000 is now under construction.

▶ Unusual mining activity is expected this season in the Ferry placer district, near Fairbanks. Val Diebold, postmaster at Ferry, has transferred his property on Eagle Creek to a representative of Gold Standard Mine Company. The new holders expect to bring in a Becker-Hopkins one-bucket dredge of the type successfully used last season on the Triple-X Placers. Several other new hydraulic plants will be put in. Nels Jackson is said to be ready for large-scale hydraulic and bulldozer work on Totatlanika Creek. Neil Turner and his brother will work Platt Creek, 20 miles east of Ferry. Joe Koska and Albert Barlow will operate a pumping plant on Moose Creek, and Jimmy Muir will operate a small hydraulic plant near Jumbo Dome.

▶ A 3-ft. Denver milling plant has been installed by Gus Sundfelt, E. G. Lindstrom, R. S. Fox, and A. L. Renshaw, at the Gold Cord property of eighteen claims, near the Independence mine, on Willow Creek, above Anchorage. They took the property over last year and are employing fourteen men under Renshaw and have been operating the mill at capacity.

▶ Leo W. Williams, of Everett, Wash., secretary of Yukon-Noranda Gold Mining & Exploration Company, reports the corporation's property 173 miles west of Whitehorse, Y. T., includes 5 miles of gravel, 300 ft. wide, with bedrock 8 ft. deep. T. C. Richards reports 1,616 oz. of gold from 45 tons of concentrates, besides 532 oz. of pure gold, last season from the Laforma group of fourteen claims in the Carmacks area near Whitehorse.

▶ Golden Zone Mining Company is said to be employing 42 men in the Anchorage district of Alaska. It expects to make a 60-per cent saving by flotation and to store the rest of the product to be treated later by cyanide process.

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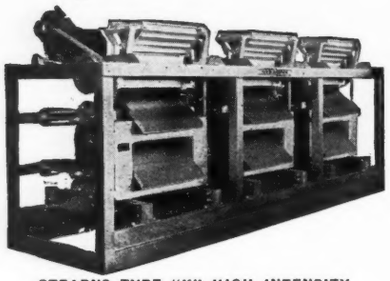

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TRI-STATE

Operations Resumed at Some Mines

Higher price for zinc concentrate encourages some operators to reopen properties —Slight improvement in employment is noted

▶ With the mark-up of zinc concentrate prices from $35.50 to $37.50 per ton early in March, and the steady demand for concentrates, operations were resumed at several properties, and the number of mills operating has again reached the 50 mark. If there were any real encouragement that present or slightly higher prices could be obtained in the future some new prospecting and development work might be expected.

▶ The Eagle-Picher Mining & Smelting Company resumed operations at its American mill in Oronogo, Mo., recently, re-employing about 75 men. As a result operations were resumed at the Oronogo Mutual Mining Company's open pit and at the D.C.&E. mine, which is being operated by John Skinner and associates.

▶ The Boulder Lead and Zinc Company has unwatered the south shaft on the McBride land, a mile north of Chitwood, Mo., and is shipping ore to the mill of the Burton Mining Company. The ore is transported in trucks. F. E. Burton is in charge.

▶ The Eagle-Picher Mining & Smelting Company resumed operations at the Hum-bah-wat-tah No. 2 mine coincident with the increase in zinc concentrate price to $37.50.

▶ The Hays-Manning Mining Company has developed sufficient ore at its property southeast of Joplin, Mo., and mill operations are under way. J. C. Manning is in charge of operations.

ANNUAL MEETING OF AMERICAN ZINC INSTITUTE

CONVENING in St. Louis, Mo., on April 29 and 30, members of the American Zinc Institute will be addressed by W. R. Peabody, Secretary American Tariff League, on the objectives of reciprocal trade agreements. The legislative outlook will be discussed by R. S. Smethurst of the National Association of Manufacturers. A review of the zinc market will be by H. H. Wanders, market editor, Engineering and Mining Journal.

THE FOREIGN zinc concentrate situation will be discussed by J. T. Hall, Callahan Zinc-Lead Company. A paper on zinc alloy die casting will be presented by C. R. Maxon, New Jersey Zinc Company, and electro-galvanizing will also be discussed.

▶ Nearly 40 men were re-employed when the Kropp mine and mill, a mile southwest of Hockerville, Okla., was placed in operation by the Davis-Big Chief Mining Company recently. C. E. Niday is in charge.

▶ The Romo Mining Company has completed its mill on the Indian Catholic Mission lease near Lincolnville, Okla., and operations have started. The mill capacity is 20 tons per hour. It was built in part from material salvaged when the former Discard mill of the Century Zinc Company, south of Baxter Springs, Kansas, was razed. Luther Owen, of Joplin, is in charge.

MICHIGAN

Smelter Practice at C. & H. Being Improved

Copper will be cast vertically in water-cooled molds—About 60 per cent of smelter output is scheduled for this method of operation

▶ During 1939 Calumet & Hecla Consolidated Copper Company produced 28,915,000 lbs. of copper at an average cost sold of 8.81¢ per pound according to the company's annual report. There was also produced during the same period from the reclamation plants at Lake Linden and Hubbell 23,400,000 lb. of copper at an average cost sold of 6.19¢ per pound. These figures do not include depreciation and depletion. The average selling price for the year was 10.18¢ per pound.

At the Kearsage operations the Ahmeek No. 3 shaft was sunk 368 ft. to about 50 ft. below the 48th level. Development was limited to No. 3 shaft, and consisted of 4,507 ft. of drifting from the 41st level down to and including the 48th level. Copper values in the bottom levels were lower than in the levels above, the vein narrower and more irregular. However, not enough development has been done to justify definite conclusions. At the Conglomerate Branch, mining at No. 12 shaft continued through October, at which time all of the commercial rock had been mined and the shaft was permanently closed. Mining began in this lode in 1866 and continued almost uninterruptedly for a period of 73 years, during which time it produced upwards of 3,275,000,000 lb. of copper.

Both the Lake Linden and the Tamarack plants worked throughout the year under normal conditions. The grade of sand treated was slightly below the average of the remaining reserves. The combined results for the year and since starting follow:

	1939	Since Starting
Tons treated....	2,574,000	33,672,000
Assay (heads) %	0.548	0.657
Assay (tails) %.	0.092	0.125
Pounds refined copper	23,400,000	357,343,000
Pounds refined copper per ton of sand treated	9.09	10.61

Of the production for the year 7,269,000 lb. was from table treatment, 12,909,000 lb. from leaching, and 3,222,000 lb.

from flotation. At the current rate of recovery, the remaining Conglomerate sands should last from about four to four and a half years. The Calumet mill at Lake Linden with its auxiliary grinding plant discontinued operations with the closing of the Conglomerate mine. It is being maintained for the present in serviceable condition. During the year 164,526 tons of Conglomerate rock was stamped.

At the Ahmeek mill there was stamped 759,301 tons of Kearsage amygdaloid rock from the Ahmeek mine and 30,996 tons from the Peninsula Copper Company territory. The mill is operating at its best metallurgical efficiency, but at about 50 per cent of capacity. During the year this department received 43,716 tons of concentrates and mass, and smelted 42,429 tons. From the material smelted there was produced 54,187,766 lb. of refined copper. Copper oxide shipped to customers amounted to 1,855 tons, containing 2,832,335 lb. of copper. Under a license agreement with the American Metal Company, the smelter is being equipped to cast billets in water-cooled molds. Similar vertical casting of cakes, inaugurated in 1938, has resulted in an improved and highly desirable product. When the billet casting equipment is completed, the proportion of C&H product cast vertically in water-cooled copper molds will amount to over 60 per cent of the smelter output.

MEXICO

Small Mines in Sonora and Chihuahua Active

Ore buying agencies may be established along Yaqui River—Lower exchange rate of Mexican peso further restricts purchase of supplies abroad

▶ Some slight improvement, mostly in the way of increased operations, was noted in Mexican mining with the advent of spring. The weak peso, currently six to one against the dollar, the lowest Mexican money has ever been in peace time, is generally considered to be advantageous to the industry, for, despite the 12 per cent export and other high taxes, it is obtaining more pesos from exports, and as most of its commitments are in pesos, this is affording a good profit. But the six to one rate is not so good for the purchases of machinery and equipment and other obligations that must be settled in dollars.

▶ Ore buying on a considerable scale is being arranged by Minerales Sonorenses, S. A., properties of which are near Hermosillo, Sonora, Felipe Bernal, Jr., general manager. The company is to open ore buying agencies along the Yaqui River. It now has two such agencies, both in Sonora, one at La Dura, the other at Tonichi.

▶ Establishment of a plant reported to cost 20,000,000 pesos ($3,336,000) has been started by the Ministry of National Economy at Zoro, on the borders of Michoacan and Jalisco, near Yuercauro, a railroad center. Private capital is

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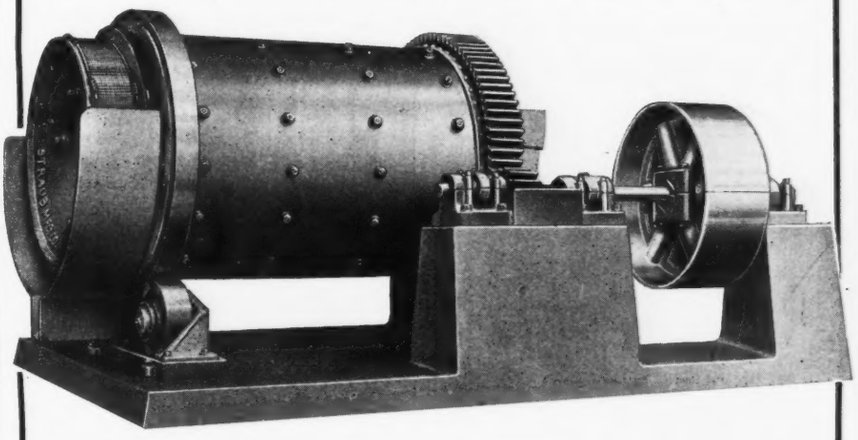

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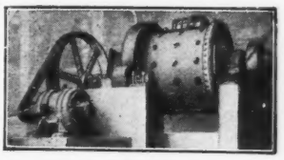

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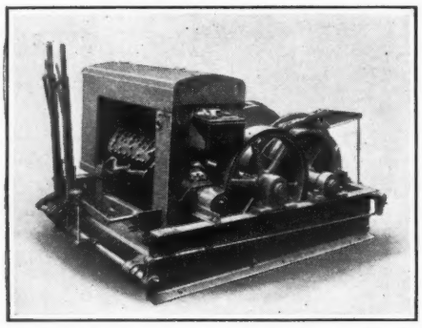

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▶MEXICO

being enlisted for the enterprise, which will be directed by the Government. The plant is to handle iron ore produced in Michoacan, Jalisco, and Colima.

▶ As incorporation of free lands in various parts of Mexico containing gold and other metals and minerals into the Federal mineral reserves has not produced the expected results, as Mexico still lacks full facilities for this exploitation, the Ministry of National Economy announces annulment of decrees ordering this incorporation.

▶ Los Mamentos mines, near Villa Ahumada, Chihuahua, R. H. Sutton, general manager, has confined production to high grade silver-lead ore because of prevailing world metal market conditions.

▶ Gold-silver-lead ore at the rate of about 20 tons daily is being obtained from mines at San Pedro de Corralitos, Chihuahua, that were recently leased by J. H. Blackwell of El Paso, Tex. A 300-ft. drift is being prepared on the 200-ft. level. Power is provided by a 75-hp. gasoline engine. A crew of 58 men are working under the direction of E. J. Carlin and Manuel Chavez. Assaying is in charge of Manuel Carrasco.

▶ Daily production of 50 tons of gold-silver ore is reported by Cia. Minera Las Animas, S. A., Juarez, Sonora, H. L. Givan, president and general manager. This ore is being treated at the company's 50-ton cyanide plant. Thomas Bostick is mill superintendent and Johnston Elliott is in charge of the smelter.

▶ Gold-silver ore at the rate of from 75 to 90 tons daily is being treated by the 125-ton cyanide plant of Cia. Explotadora de Metales, S. A., Juan Martinez, general manager, on its properties at Panuco, Sinaloa.

▶ The Moctezuma Copper Company, in Sonora, Mexico, a subsidiary of Phelps Dodge Corporation, produced 218,903 tons of ore, in 1939, production coming from levels 400 to 900, inclusive. Development advances consisted entirely of stope preparation footage. Mining efficiencies showed an improvement over those of the previous year. A compressor was transferred from Tyrone to give additional air capacity. The concentrator treated 216,981 tons of ore, with improved extractions and costs. New flotation cells were installed and reconditioning of concentrator unit No. 2 was nearly completed at the end of the year. The Churunibabi property shipped siliceous ores to Douglas, but all other outside properties were inactive. The entire ranch holdings within a zone of 100 kilometers from international boundary line were either sold or transferred to Mexican citizens in the month of November. This action was made necessary by Federal decree. Production from the San Carlos property, in Chihuahua, Mexico, was 66,764 tons of lead-silver ore. Mine operation was continuous throughout the year. The necessary development work for stope preparation and ventilation openings was carried on. Efficiencies improved towards the end of the year. The mill treated 67,049 tons of ore. Changes in metallurgy led to improvements in extraction. A new 350-hp. diesel power unit installed late in the year greatly improved the power situation. Necessary dwelling houses, a schoolhouse, and a small hospital were erected.

CANADA

International Nickel to Increase Production

Open-pit operations at higher rate and concentrator capacity to be enlarged from 12,000 tons to 20,000 tons daily—St. Joseph Lead Company takes option on gold-zinc property in Quebec—Labor strike at Pioneer mine called off

▶ The International Nickel Company of Canada, in issuing its annual report reviews record production in 1939 of nickel, copper, and platinum, and states a policy of major expansion for operations in the Sudbury district. Robert C. Stanley, president, reports net earnings of $36,847,466 after all charges including provision of $11,322,121 for taxes and $10,480,990 for depreciation, depletion and retirement. Nickel sales of 210,194,135 lb. far exceeded any other year in the company's history and represented 82.1 per cent of world consumption. In 1939 International Nickel also supplied 6.5 per cent of world copper and 48.16 per cent of world platinum metals. Mining operations resulted in the hoisting of 7,273,835 tons of ore and adding 12,226,000 tons to reserves. Ore reserves of 224,594,000 tons are valued at more than two and a half billion dollars, based on an average ratio of two parts nickel to three parts copper and valuing copper at 10c. per pound and nickel 30c. per pound. Open pit operations at the Frood and Garson mines are to be increased to a daily output of 12,000 tons. The present concentrator capacity of 12,000 tons is being increased to 20,000 tons daily. Last year the company spent $8,598,286 for plant addition and improvement, including more than three million on the Petsamo nickel property in Finland, where a total of $6,723,908 has been invested.

▶ McKenzie Red Lake Gold Mines attained new production records in the past year, cut down operating costs from $6.82 to $5.95 a ton and advanced working capital to $629,884, according to the annual report issued by W. G. Armstrong, president. The managing director, M. F. Fairlie, reports that large unexplored areas are to be investigated, including the granodiorite hanging wall between the 850 and 450 levels. The granodiorite, formerly believed to be barren, has been proved productive.

Quebec

▶ In the annual report of Waite Amulet Mines, the manager, Thomas E. Little, states that the discovery and development of the Lower "A" orebody of more than 3,000,000 tons was the most important advance of the last two years. The new 1,000-ton concentrator, started

last October, has been treating ore from the north section, but before the end of this year the entire production can be supplied from lower "A" orebody.

▶ Several wide oreshoots of good grade have been indicated on the property of Lacoma Gold Mines, Tarernier Township, and development work continues to open up favorable conditions. On the first level drifting in well-mineralized quartz and altered diorite shows 80 ft. of ore averaging $9.80 a ton. Good ore is also being developed on the second level. James P. Norrie is the general manager.

▶ St. Joseph Lead Company has optioned the gold-zinc property of Quebec Manitou Mines, 10 miles east of Val d'Or. About $350,000 has been spent in blocking out 11,600 tons in No. 2 orebody, averaging 0.17 oz. gold, and 12 per cent zinc, plus the partially developed No. 1 orebody, which shows an average width of 30 ft. and a length of 400 ft. on the 200 and 350 levels. St. Joe has started a program of diamond drilling and will spend $100,000 on underground work if results are satisfactory. Another $600,000 is to be provided to build a mill and put the property into production. St. Joseph Lead would hold 60 per cent control of a new company to be formed and all expenditures would be repaid out of first production.

British Columbia

▶ In the Kennedy Lake area, in the southwest coast of Vancouver Island, the Amparo Mining Company, of Philadelphia, which has substantial interests in Mexico, has taken an option on the old Rose Marie mine. The Rose Marie was developed many years ago by British interests; though some promising showings were found, they were not, at the old price of gold, worth exploitation.

▶ Milling was resumed at Pioneer Gold Mines Ltd., in the Bridge River district, on March 11, after five months of inactivity due to the strike of employees last Oct. 8. Nonunion men, members of the Co-operative Committee who remained loyal to the company, returned to work in the week previous after Premier Pattullo had given assurances that adequate police protection would be provided should violence occur. The C.I.O. union employees meanwhile informed the management that they were calling the strike off and were willing to return to work.

▶ A company known as the Coast & Lakes Alluvial Company will commence operations this spring on its ground, reported to contain about fifty million yards of gold-bearing gravel, situated near Beaver Pass, some 20 miles west of Barkerville, in the Cariboo. The company proposes to uses bulldozers and Carryalls to handle the gravel, thus conserving water which will not be used except for washing the gravel, and estimate that cost of handling will be in the neighborhood of 10c. a yard. The company is said to have British backing.

▶ In the Nicola area, the Consolidated Nicola Goldfields, Ltd., which is financed partially from England, is moving in machinery to complete its mill and the management hope to commence production within the next few months.

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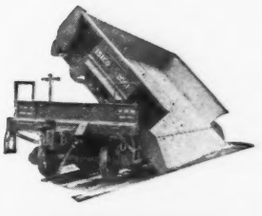
Bulletin No. 71 describes these cars, as well as the complete Koppel line of over seventy-five different types available. Would you like a copy of this informative bulletin?



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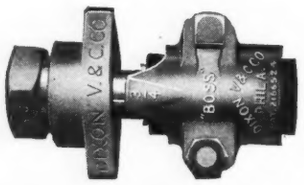
Heavy Type, Style WHD-9, sizes ¾" and 1".



"BOSS"

WASHER TYPE

AIR HAMMER COUPLINGS

Except for the clamp, these are exactly the same as the "DIXON" Air Hammer Coupling described above. The sturdy malleable iron "BOSS" Clamp used on this coupling has extended fingers which engage the collar on the steel stem, completely anchoring the entire coupling to the hose, and eliminating the danger of leaks, pressure losses and blow-offs.

All parts malleable iron, cadmium plated to prevent rust. Compact Type, Style WLB-21; sizes ½" and ¾". Heavy Type, Style WHB-32; sizes ¾" and 1".

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Finland's new and largest copper smelter at Imatra is now only 10 miles from the new Russian border, against 90 miles before the Russian invasion. Copper concentrates from the Outokumpo mine are shipped to the above smelter. The largest electric furnace in Europe is said to be used at this smelter. The plant indicated as the smelter on page 65 of February E.&M.J. is really a power plant

AFRICA

Greater Gold Output On Rand Under Way

Act permitting payment of full price of 168 shillings per ounce will increase exploitation of lower-grade ore—Gold production reaches new high

▶ The South African government's budget provides for a rearrangement of gold-mining taxation which seems to assure the continuing development and equipment of new producers. The appropriation of all proceeds in excess of 150s. per ounce, which has been in force for some months, is abandoned. The mines will receive the full price for their gold, now 168s. per ounce; but they will pay realization costs (now borne by the Union Treasury), and will pay a new special tax of 9 per cent on profits. As the realization expense will be small, and the new income tax is aimed to bring in about £3,500,000, the gold-mining industry is expected to benefit by some £6,500,000 annually. In this change the mining interests see evidence of a more friendly government attitude toward the gold mines, and it is already evident that the flow of new capital into the industry is to be resumed. The reason for the change is that the gold mines are producing the most desirable war material, providing dollars now much needed to pay for planes and other things being purchased in the United States. It is an arrangement which will be of particular benefit to producers from low-grade ores, as the appropriation of all in excess of 150s. per ounce was really a tax on gross earnings, while the 9 per cent tax proposed will be on profits only. Several of the large producers will be particularly benefited by being enabled to treat larger amounts of low-grade ore.

▶ In January the gold production of the Transvaal reached the new high total of 1,135,482 fine ounces, which is 34,651 oz. above the previous high record. This indicates a production this year of between 13,500,000 and 14,000,000 oz., against 12,891,344 last year.

▶ It is reported that Anglo American Corporation of South Africa is about to finance Western Reefs to the extent of £1,000,000 to enable it to erect a reduction plant and begin production by the middle of next year.

▶ There is a report that the Union Government is about to lease to Western Holdings sufficient additional area adjoining the St. Helena-Vlapplaats ground to form the basis for the flotation of a big working subsidiary in the Orange Free State. The Union Corporation is expected to manage the subsidiary and, with Selection Trust (A. Chester Beatty) to provide the required capital.

▶ Union Miniére du Haut-Katanga produced 123,000 metric tons of copper in 1939, which is approximately the same as the preceding year. As a result of being in a position to obtain the higher prices which have ruled, there was an increase in the year's profit. The production of cobalt was larger last year.

▶ Equipment of the property of O'Okiep Copper Company, Ltd., in Namaqualand, South Africa, was delayed by war, but milling operations started in March, 1940, and smelter production of blister copper is expected to begin in May, according to the annual report of the Newmont Mining Corporation. Most of the construction materials and operating supplies were delivered at the property before declaration of war, and cost of the construction program is expected to come well within estimates. This South African company has contracted to sell its production to the British Ministry of Supply.

▶ In a labor strike at the Nkana copper mine, in Northern Rhodesia, it was reported that several natives were killed and many wounded when militiamen fired to break up a riot. Natives have been on strike since March 17 for a 25 per cent wage increase and an increase of 5 per cent to cover higher living costs. Settlement was made early in April.

AUSTRALIA

Mount Isa Expands Exploration

Extension of higher-grade orebodies to be determined—Open-cut mining methods may be employed on low-grade gold deposit in Queensland

▶ Development work at Mount Isa is to be intensified in order to open up adequate tonnages for the enlarged mill, and the exploration of the higher grade orebodies is to be vigorously pursued in an endeavor to keep up the milling grade. Equipment installed during the year comprised a set of Traylor heavy-duty rolls, 72x20 in. in the crushing section, and a 10-ft. Hardinge ball mill with 16-ft. Multizone classifier in the fine-grinding section. The mill is now treating about 15,000 tons weekly, or 20 per cent more than hitherto. Operating costs for the year ended June 30, 1939, including all costs on lead bullion up to delivery to ship, Townsville, but excluding all charges for freight on lead to England and for lead refining, and also all charges for the production of zinc concentrate, were:

Year Ended June 30

Per ton of ore treated, Australian currency

	1939 s.	1939 d.	1938 s.	1938 d.
Mining and development	12	11	13	5
Milling	5	2	5	0
Smelting	6	0	5	11
Administration and general expense	2	1	2	2
Delivery of bullion f.o.b. Townsville	2	1	2	3
Totals	28	3	28	9

▶ Gold Mines of Australia, Ltd., has taken options over extensive aseas at Kingston, some 15 miles south of Brisbane. The deposits have been known for about 60 years and have been worked spasmodically for 40, but they are low grade and would require working on a large scale with modern equipment in order to give an adequate return. Open-cut methods can be applied to the mining of the deposit, testing work on which is to commence immediately.

Western Australia

▶ Gold yield of Western Australia for 1939 was 1,214,237, 46,446 oz. more than last year and the best year's return since 1914, when 1,232,997 oz. were produced.

▶ Big Bell Gold Mines, Ltd., operating at Big Bell, near Cue, milled 447,322 short tons during 1939 for a return of 59,727 oz., an average of 2.67 dwt. per ton. The drop in grade during the past year was a measure designed to take the fullest advantage of the enhanced price of gold. It is reported that the scope of open-cutting operations at the property is becoming limited, and that before long underground mining methods will become necessary.

▶ Parings Mining & Exploration Company, Ltd., Kalgoorlie, is to increase mill capacity from 7,000 to 9,000 tons per month.

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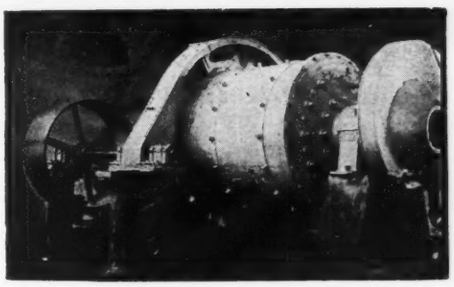

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Reclaiming Muriate of Potash in Warehouse.

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At mines, mills and smelters, Sauerman Power Scrapers are being used most effectively in the stockpiling of both raw and processed materials, either in the open or inside buildings.

One of the great advantages of this equipment is its flexibility, which permits Sauerman engineers to adapt each scraper installation to the exact needs of the job. Moreover, the first cost of a Sauerman installation is reasonable, maintenance amounts to very little, and the simplicity of operation makes it possible to place the control of even the largest installation in the hands of a single operator.

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ELIPTEX SCREEN

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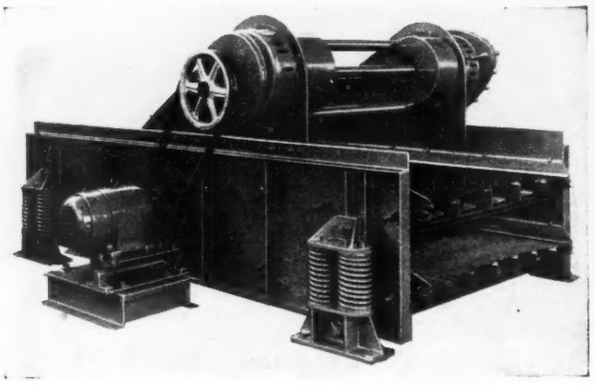

Patents applied for — 5′ x 12′ Double Deck Eliptex Screen

The secret of ROBINS ELIPTEX Screen lies in its unique elliptical motion, uniform throughout. This action propels the material forward, at the same time turning it over and over again giving each piece countless opportunities to pass through the mesh. Hence a closer sized product. The design of the vibrator is such that the screen runs smoothly and quietly. It is strong and simple in construction. Wide range of sizes available in single and multiple decks. Write now for all particulars and prices.

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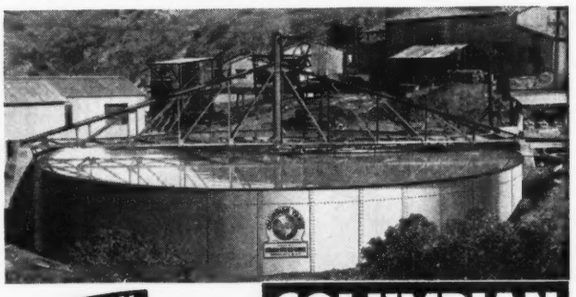

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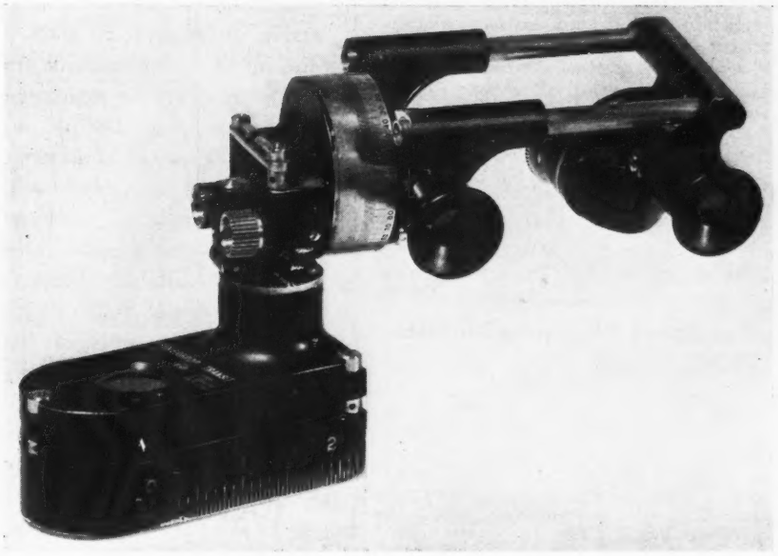
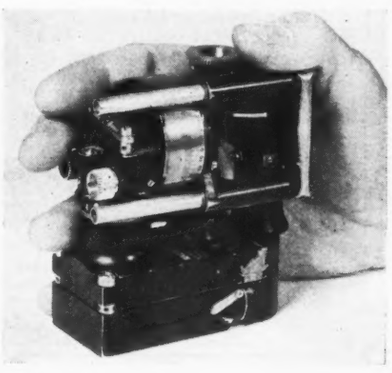
EQUIPMENT NEWS

A New Universal Reconnaissance Survey Instrument



MANY recent developments relating to reconnaissance, such as aërial maps and geophysical surveys, have resulted in a need for a new portable survey instrument, comparable with the famous Brunton in portability but capable of a wider range of more accurate and rapid work. The Suverkrop Transit shown in the accompanying illustrations was developed by Lew Suverkrop, Bakersfield, Calif., with the hope of providing engineering, military, and scientific reconnaissance with an instrument meeting today's problems as neatly as those of 45 years ago were then met by the Brunton.

The new instrument is pocketable but indicates vertical and horizontal angles with an accuracy of 5 minutes of arc. The peculiar combination of compactness and accuracy results from a new method of determining magnetic azimuth of a course—a new principle. Instead of the sight being fixed to the compass case, it is rotatable. While the sight is aimed at the object, the compass case is oriented by rotating it until the needle coincides with an index mark within the case. Then the magnetic azimuth is read from a goniometer which indicates the angle between the line of sight and the oriented case. This angle is calibrated from zero when the sight is directed north and the needle coincides with the index mark.



The goniometer comprises a dial mechanism with degree divisions as wide as those of a circle of diameter several times the maximum dimension of the new instrument. Using the needle only at its index mark is the same as employing an ordinary compass only when it indicates "zero," thus eliminating all but the central trough-like segment of the compass case. Pivoting the needle near one end and observing it under a magnifying glass gives the effective accuracy of an ordinary compass many times the bulk of the new instrument. Optical means bring clearly into vision the object, cross- and stadia-hairs (seen with the right eye); and the level, compass needle, and needle index (seen with the left eye). A new level with two elements moving against glasses of different radii combines accuracy with quickness. Angles are read only after removal of the instrument from the eyes. This precludes fudging, heretofore common in "checking" compass readings. After an hour's practice with the instrument, a magnetic azimuth may be repeatedly checked to plus-or-minus 5 minutes of arc, using the instruments merely hand-supported. Observations take less than one-half minute of time. Both vertical angle and magnetic azimuth are automatically obtained in one observation. The overhanging construction permits observation of vertical angles from zenith to nadir, a particular advantage in mining work. Folded, the instrument is conveniently carried in a light, strong duraluminum belt case.

Unusual versatility is another result of the new design. It is a self-contained transit and may be mounted on a light camera tripod for turning off vertical and horizontal angles. By clamping the line of sight so that it is parallel to one side of the case, the instrument becomes a small but complete telescopic plane-table alidade. The squared end of the case used in conjunction with a straight-edge held on the plane table provides the instrument with its own parallel rule. As illustrated, the telescopic sight may be reversed, bringing the line of sight close to the vertical axis and making the instrument self-supporting on the plane table.

Many other uses include those of level, hand level, abney level, and bubblesextant. Dip and strike of rock beds may be determined in several ways. A single "dip shot" in a bedding plane gives in one observation both dip and the azimuth of the dip. Applying the instrument to a bedding plane exposed in a hanging wall, dip and strike may be determined by observing needle and level from below. It has been used as a goniometer for reading dip and strike of beds in cores oriented from deep boreholes. The instrument has a wide field of usefulness in surveying generally where an extremely portable instrument is an advantage, and where an accuracy of $1\frac{1}{2}$:1000 is adequate.

Phelps Dodge Announces New Type of Copper

A NEW TYPE of copper resulting from ten years of research and development has been announced by Phelps Dodge Copper Products Corporation, New York. Known as "PDCP," the new copper is said to have superior characteristics for use in the electrical industry—greater conductivity, ductility, and fatigue resistance, and finer surface quality. Due to a novel method of production, the metal is free from imperfections such

New type copper shown in cathode particles cold-pressed into a billet for subsequent extrusion into finished shapes

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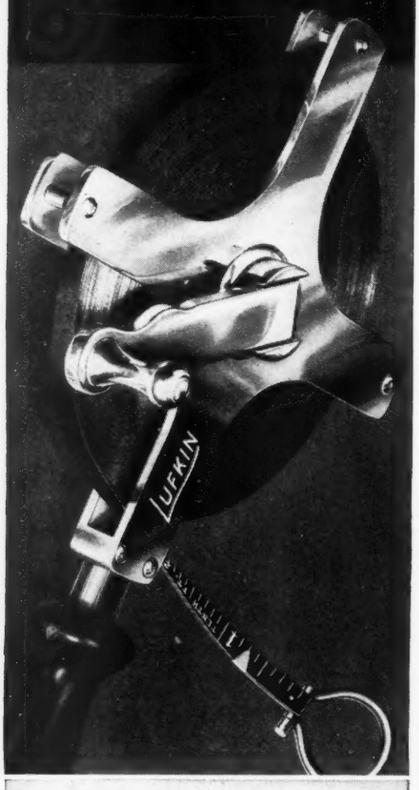

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as slivers and oxides that are inherent in copper products fabricated by the customary process of casting and hot-rolling.

By the new method of production, electrolytic cathode copper is broken into small pieces and transported to the fabricating plant in containers filled with weak sulphuric acid. After washing, the copper is baled cold into billets by mechanical pressure. Billets are then heated in a reducing atmosphere in a gas-tight furnace to a temperature below the melting point of copper. In this condition they are transferred to a hydraulic press in which the pieces of copper in the billet are coalesced and extruded through a die block in the form of a rod, wire, or other desired shape. By avoiding the melting of cathode copper, and using only mechanical pressure in a reducing atmosphere to coalesce the particles of metal, the new product is oxygen-free and has other enhanced properties. A new fabricating unit for the production of commercial shapes of the new copper has been established at the company's mill, Bayway, N. J.

High-Speed Whiteprint Machine

OZALID CORPORATION, 354-Fourth Ave., New York, N. Y., announce its Model "A" automatic high-speed white print machine that employs a new quartz-envelope high-pressure mercury-vapor

lamp, which provides an extremely fast printing speed, ranging up to 20 linear feet per minute, and assures uniform distribution over the entire printing surface. This lamp is guaranteed for 1,000 hours.

This unit is available in two sizes for production of prints up to and including 42- and 54-in. widths. An ingenious device automatically separates the print from the original after exposure. The original is returned to the operator in front of the machine, and the exposed print is automatically conveyed to the developing unit, where, after dry development, it is discharged at the rear of the machine ready for immediate use.

A variable transformer in the primary circuit permits a variation of intensity

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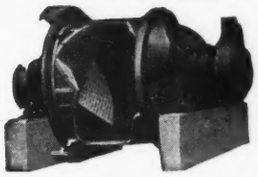

Williamson Mills from 3½' to 10½' in diameter are in use by leading mining companies the world over. For over 15 years, they have maintained their advantages of high efficiency and low cost operation.

Let us help solve your cost-cutting problem.

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Placer dredges built by Bucyrus-Erie have operated successfully in placer deposits all over the world. Your dredge, built by Bucyrus-Erie, will be the best available because of that experience, because of the unequalled facilities of Bucyrus-Erie for designing and building the RIGHT dredge for YOUR particular job. Ask for full information.

BUCYRUS-ERIE COMPANY

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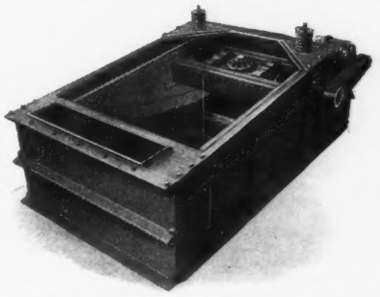
of the high-pressure mercury-vapor lamp from full brilliancy to 60 per cent of light without loss of energy. This dimming arrangement is said to be extremely important, for it allows the operator to select the desired intensity, and permits continuous and uniform production of prints, despite variations in tracings.

The high-pressure mercury-vapor lamp is cooled by an alternating air blast, which passes through the space between the revolving contact cylinder and the fixed cylinder surrounding the quartz-envelope high-pressure mercury-vapor lamp.

New Rod Deck Screen

NORDBERG MANUFACTURING COMPANY, Milwaukee, Wis., announce its development in screening equipment, es-Symons rod deck screen, said to be a new pecially adapted for removing fines from wet, sticky materials. The outstanding feature of this screen is its screening surface, consisting of spring steel rods instead of some form of wire mesh as commonly used. These rods create long,



slotted openings which are said to permit rapid removal of fine material, and do not clog even when the feed is wet and gummy. For this reason, this screen finds its greatest application in the mining field, but it can also be used wherever the sizing is not confined to square openings.

Other features are said to be large capacity for sticky ore, and low maintenance cost. The individual spring steel rods can be quickly inserted with the hands, no tools being required. Any rod or group of rods can be replaced without disturbing the rest of the screening area. The rod deck screen is available in two sizes, 3x8 in. and 4x8 in.

BULLETINS

Bulldozers. R. G. LeTourneau, Inc., Peoria, Ill. General 1940 Catalog describes and illustrates the manufacturer's line of products and services covering its bulldozers, angle dozers, rooters, Carryall scrapers, and other units. Pp. 32.

Rock Drills. Holman Bros., Ltd., Camborne, England. Catalog D-786-39 offers a comprehensive description and many illustrations of the manufacturer's line of rock drills in an attractive book that also contains specifications of many drills, together with engineering data. Pp. 100.

Couplings. Victaulic Company of America, 30 Rockefeller Plaza., New York, N. Y. Bulletin M-39 describes and illustrates installation and operating features of the company's couplings for mine pipe systems handling compressed air, water, and slimes. Pp. 23.

Industrial Health. Committee on Healthful Working Conditions of the National Association of Manufacturers, 14 W. 49th St., New York, N. Y., offer an informative booklet entitled "Who's Too Small for a Health Program?"

For a SAFE, PROFITABLE INVESTMENT, *choose*

Leahy HEAVY DUTY VIBRATING SCREEN

Here's an example of superior engineering design and construction inherent in the entire Deister Concentrator line — the Leahy Type "C" No-Blind Vibrating Screens with TRI-VIBE.

For fine screening operations, the Leahy's free-swinging screen jacket, triple powered with the dynamic Leahy differential vibration, assures low-cost screening, with increased capacity and uniformity.

Put these advantages to work for you. Detailed information on request. Write today.

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THE ORIGINAL DEISTER CO.
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The Perfect Bit-Metal

Low temperature setting protects diamonds used in HI-CASTE Bits—and provides the lowest diamond cost per foot. HI-CASTE Bits are available in flat-faced and double-round-nose types. Also upon request, any other standard shape, size, wall thickness, or thread. Write for descriptive literature.

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157 CHAMBERS STREET, NEW YORK CITY

Diesel Tractor. Allis-Chalmers Mfg. Co., Milwaukee, Wis. Form MS 248 describes and illustrates features of the company's new AS 14 six-cylinder diesel engine tractor. Pp. 31.

Metal Powders. Charles Hardy, Inc., 415 Lexington Ave., New York, N. Y. Folder describes features of Sinterloy, a powder for the production of steel parts. Pp. 4.

Phosphorus - Iron Alloys. Monsanto Chemicals Co., St. Louis, Mo. Bulletin No. 2, published by the Phosphate Division, is a report of experimental research investigation on corrosion and mechanical influences of alloying elements in low-alloy steels. Pp. 62.

Lubricant Fittings. Alemite Corp., 1828 Diversey Blvd., Chicago, Ill. Form 21-17 describes the company's Lubriguard to prevent overlubrication of ball and roller bearings. Pp. 4.

Furnace for Detachable Bits. Ingersoll-Rand Co., 11 Broadway, New York, N. Y. Leaflet 2609 describes and illustrates the company's heating furnace for servicing the manufacturer's Jackbits. Pp. 2.

New Hammermill. Hammermill Pennsylvania Crusher Co., Philadelphia, Pa. Bulletin 1030 describes the manufacturer's two-way central feed new reversible hammermill. Pp. 4.

Cottrell Process. Research Corporation, 405 Lexington Ave., New York, N. Y. This new booklet, entitled the "Cottrell Process of Electrical Precipitation," is issued jointly by Research Corporation of New York, Western Precipitation Corporation, of Los Angeles, and Precipitation Company of Canada, Ltd., Montreal. A brief historical summary of electrical precipitation is given and the Cottrell process is described and many illustrations show installations. Pp. 21.

Copper Paint. Phelps Dodge Refining Corp., 40 Wall St., New York, N. Y. Folder describes the manufacturer's new copper paint for use on wood, metal, and concrete. Pp. 5.

Wheel Chart. Meehanite Research Institute of America, Inc., 311 Ross St., Pittsburgh, Pa., announces a handy wheel chart containing engineering data about the various types of Meehanite castings available to industry.

Automatic Boiler Service Units. Roots-Connersville Blower Corp., Connersville, Ind. Bulletin 260-B 14 C describes the manufacturer's boiler service units for plants using steam for processing. Pp. 6. **Gas Boosters.** Bulletin 32-33-B-11 describes and illustrates the company's line of rotary positive gas exhausters and boosters. Pp. 20.

Equipment Folder. Robins Conveying Belt Co., 15 Park Row, New York, N. Y. Bulletin 109 briefly describes and illustrates the line of conveying and other equipment manufactured by the company. Pp. 4.

Ball Mills. Denver Equipment Co., 1400-17th St., Denver, Colo. Bulletin B2-B2 describes and illustrates the manufacturer's convertable 5x5 ft. ball mills. Pp. 2. **Rake Classifiers.** Bulletin C5B3 describes the company's Type C simple and duplex rake classifiers. Bulletin F11-B5 describes features of the manufacturer's "Sub A" (Fahrenwald) Flotation Machine. Pp. 2. **Bolted Steel Tanks.** Bulletin T2-B1 describes and lists specifications of various galvanized water and fuel oil tanks. Pp. 2.

Mercury Arc Rectifiers. Allis-Chalmers Mfg. Co., Milwaukee, Wis. Bulletin B-6064 comprehensively describes and illustrates the manufacturer's standard multi-anode rectifiers and provides information on its recently announced Excitron single-anode rectifier suited for the lower voltage applications from 250 to 300 volts. Pp. 39.

Pattern Compound. Tannis Silica Co., 228 N. La Salle St., Chicago, Ill. Catalog F-41 describes and illustrates uses of the manufacturer's pattern compound and other foundry specialties. Pp. 7.

Duraloy. The Duraloy Co., 12 East 41st St., New York, N. Y. Bulletin 3926-C describes and illustrates the manufacturer's line of high alloy castings and other products for industrial use. Pp. 8.

Butt Welding of Rails. Air Reduction Sales Co., 60 East 42d St., New York, N. Y. Form ADG-1069 describes features of the company's method of preparing jointless track for mine car haulage. Pp. 6.

Detachable Bucket for Truck Haulage. Brooks Equipment & Manufacturing Co., Knoxville, Tenn. Bulletin 209 describes and illustrates applications of the manufacturer's "Load Lugger" for material moving jobs wherein a 1½-ton truck employs 5 to 10 detachable buckets of 2-cu.yd. capacity for hauling materials. Pp. 4.

Welding Helmets. Mine Safety Appliances Co., Braddock Thomas & Meade Sts., Pittsburgh, Pa. Bulletin CE-10 describes the company's welding helmets and accessory protective equipment. Pp. 4. **Face Shields.** Bulletin CE-11 describes the company's new line of face shields. Pp. 1. **Oxygen Breathing Apparatus.** Bulletin BM-2 points out features of the manufacturer's Front type one-hour breathing apparatus. Pp. 4. **Dust and Fume Sampler.** Bulletin CT 3 illustrates and describes the company's new portable electrostatic dust, fume, and moisture sampler.

Portable Electric Tools. Black & Decker Manufacturing Co., Towson, Md., announces its attractive 1940 catalog covering its entire line of portable electric tools. Pp. 61.

V-Belt Drives. Dayton Rubber Mfg. Co., Dayton, Ohio. Catalog 150 has been arranged in convenient tabular form and contains a wide selection of all classes of fractional horsepower V-belt drives for machinery service. The catalog is profuse with tables enabling the finding of the drive required for any horsepower speed ratio and center distance to meet requirements. Pp. 41.

Air-Handling Equipment. American Blower Corp., 6000 Russell St., Detroit, Mich., or Canadian Sirocco Company, Ltd., 310 Ellis St., Windsor, Ontario, Canada. Bulletin A-32029 is an attractive pocket-sized book describing and illustrating the manufacturer's complete line of equipment for practically every known air-handling requirement, such as air conditioning, drying, vapor absorption, mechanical draft, dust collection, fume removal, and other air moving needs. Pp. 48.

Wire Rope. American Chain & Cable Co., Inc., Wilkes-Barre, Pa., announces two pocket bulletins describing and illustrating many uses of preformed rope in mining and stripping operations.

DEISTER'S

Latest Improvements In

PLAT-O ORE CONCENTRATING TABLES for concentrating any ore from ¼" to slimes. ***Bulletin No. 20B.***

PLAT-O HEAVY DUTY VIBRATING SCREENS for large tonnages ore, sand and gravel, crushed stone, etc. ***Bulletin No. 26.***

MULTIRAP VIBRATOR—High speed for fine screening. Non-blinding, high efficiency, long life screen cloth. ***Bulletin No. 24.***

COMPOUND FUNNEL CLASSIFIER—Gold trap for coarse gold. Preparation of ore pulps for table concentration. ***Bulletin 23.***

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THE ROSS FEEDER

Completely Controls

the flow of any size material from Storage Bins, Hoppers or Open-Dump Chutes to Crushers, Conveyors, Screens, etc.

High in efficiency. Low in maintenance and power consumption.

Furnished in sizes to suit your operation. Scalping unit to fit your chute if desired. Send full particulars for recommendation.

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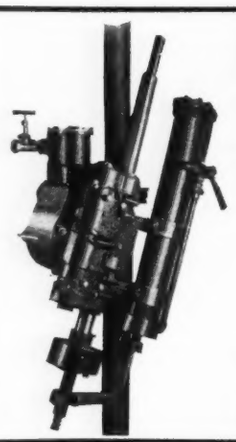

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One of Our Most Adaptable Light Air Drills

Drilling capacity with "LE" rods 250 feet. "XR" rods 500 feet. Size core recovered (EX & XR) ⅞" and ¾" diam. resp. Standard mine bar-mounting. Weight complete with rod puller 175 lbs.

A complete line of Diamond Drilling equipment.

PROMPT ATTENTION TO ENQUIRIES WHETHER FOR SALES OR CONTRACT

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INDUSTRIAL NOTES

Garfield & Co., of which G. A. Garfield is the head, has been appointed distributor for Lima Locomotive Works, Incorporated, Shovel and Crane Division, handling a complete line of Lima shovels, draglines and cranes. Headquarters for Garfield & Co. are in the Hearst Building, San Francisco, Calif.

At the twenty-first annual meeting of the stockholders of Filtration Engineers, Incorporated, of Newark, N. J., a complete stock (financial) reorganization was effected. **Thomas** C. Stephens was re-elected president, George H. Caffrey was re-elected vice-president, and Louis A. Phillips was re-elected treasurer. These officers, together with Thomas Keogh and Frank W. Young, comprise the new board of directors.

According to a recent announcement by Herman Schifflin, manager of Allis-Chalmers Manufacturing Company's crushing, cement and mining department, William C. Johnson has been made sales manager of the crushing and cement machinery division.

Walter L. Maxson has been appointed sales manager and chief engineer of the mining **machinery** division of Allis-Chalmers Manufacturing Company.

Blaw-Knox Company, Pittsburgh, Pa., has issued to employees a second primer on the business in which they play a part. This is the second report of its kind, the first one having been issued a year ago on the company's financial structure. The current report is largely a pictorial description of the manufacture of Blaw-Knox products.

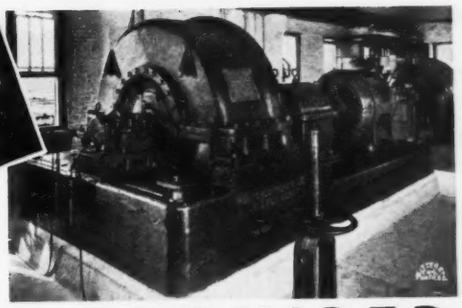
Hersey & Company, Inc., manufacturers and engineers, has discontinued its agency business and is now confined to manufacturing air appliances in its own shop at 2021 Minor North, Seattle, Wash. The agency business in Salt Lake City, Utah, has been turned over to **D. C. Forbes,** its former manager.

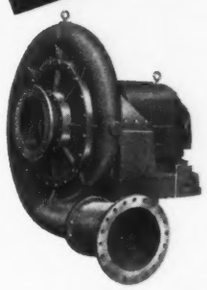
Exports of certain classes of mining and quarrying machinery from the United States in December, 1939, shown below, are valued at $1,673,511, according to the Bureau of Foreign and Domestic Commerce. They included 725 rock drills, 36 mine hoists and derricks, 371 stationary air compressors of not over 25-cu.ft. capacity, 102 compressors of over 25-cu.ft. capacity, and 36 portable air compressors. Values are shown in the table:

Rock drills	$165,118
Hoists and derricks	75,546
Ore crushing machinery	310,084
Concentrating and smelting machinery	84,526
Other mining and quarrying machinery	659,086
Air compressors −25 cu. ft.	24,178
Air compressors +25 cu. ft.	269,997
Air compressors, portable	85,012

Mine locomotives shipped by manufacturers in 1939 numbered 322, according to the Census Bureau, Department of Commerce. Locomotives for industrial use totaled 124, giving a grand total of 446 mining and industrial locomotives. Of this number, domestic shipments accounted for 242, and exports for 204. A further analysis shows shipments of 84 trolley or third-rail locomotives, 243 storage-battery, 8 diesel-electric, 51 diesel-mechanical, and 60 gasoline-mechanical or steam.

IF CENTRIFUGAL BLOWERS





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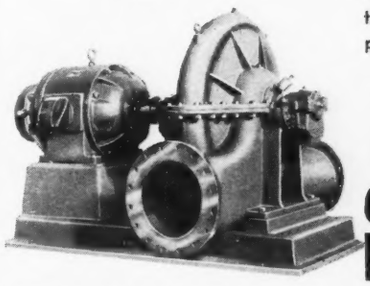
AS builders of both centrifugal and positive displacement types of blowers, we are in position to give unprejudiced advice as to the type best suited for your requirements. Blowers, Exhausters and Compressors are built in all capacities and for all purposes in the moderate pressure range. Bulletins No. 120-B11 describing centrifugal type and No. 32-33-B-11 describing positive displacement type will be mailed upon request.



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Intercone crushing is the fast, *low cost* way to turn out large tonnage of ½ to ¾-in. rock—the way to increase, not only your production, but your sales and profits.

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The "Floater" is a money saver on lubricant . . . DOUBLE SEALED against leakage. Lubrication saving is amazing and covered by our written guarantee.

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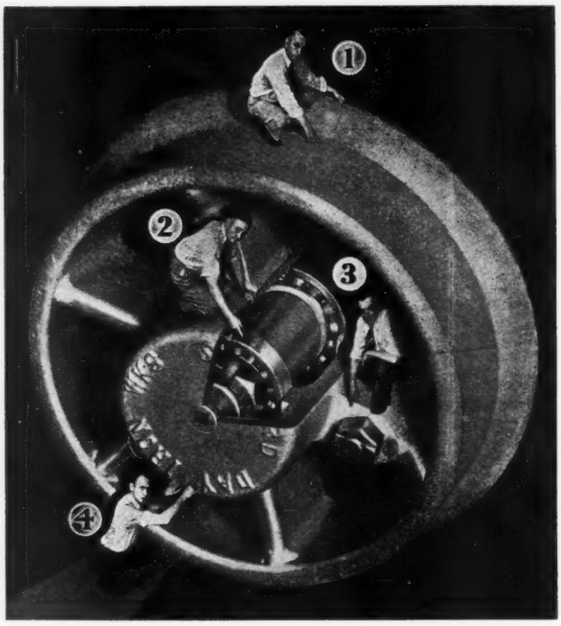
S-D "Floaters" are perfect . . . and once you try them, you will learn—as hundreds of others have learned—that no wheel can approach the economy and satisfactory service of S-D "Floaters." Write or wire now for complete information.



1—Deep chilled treads . . . true shape . . . scientific contours. And, most important, S-D "Floaters" are annealed by Sanford-Day's Patented annealing process for uniform strength.

2—The S-D "Floater" Bearing. This unusual principle permits the bearings to automatically adjust themselves and prevents any possibility of damage by pinching.

3—Demountable, just like an automobile wheel, but easier. By simply removing the lock nuts, wheel may be slipped off axle, while bearings remain in place and in perfect adjustment on the axle. Nuts are protected from damage by wheel tread.

4—Solid closed hub . . . no loose caps to come off . . . no troublesome, projecting axles, nuts, cotters or screws . . . no grease leakage.

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